STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS

ADDENDUM NO. 1
FOR
KAWAIHAE ROAD, REPLACEMENT OF WAIAKA BRIDGE AND REALIGNMENT OF APPROACHES
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII
FEDERAL-AID PROJECT NO. BR-019-1(093)

February 6, 2026

This Addendum shall make the following amendment(s) to the Solicitation:

A. TABLE OF CONTENTS

1. Delete **TABLE OF CONTENTS**, dated 12/31/25, in its entirety and replace it with attached **TABLE OF CONTENTS,** dated r2/6/26.

B. SPECIAL PROVISIONS

1. Add and make a part of the specifications the attached **SECTION 673 – INTERPRETIVE SIGN,** dated 2/6/26.

2. Delete **SECTION 627 -CATHODIC PROTECTION SYSTEM,** dated 10/03/22, in its entirety.

C. PROPOSAL SCHEDULE

1. Delete **PROPOSAL SCHEDULE Pages P-8 thru P-16,** dated 01/12/26, and replace it with attached **PROPOSAL SCHEDULE Pages P-8 thru P-16,** dated r2/6/26.

D. PLANS

1. Delete **PLANS SHEET NO. 12 DEMOLITION PLAN** dated Dec. 2025 and replace with attached **PLANS SHEET NO. ADD. 12 DEMOLITION PLAN.**

2. Delete **PLANS SHEET NO. 57 WATERLINE RELOCATION PLAN & PROFILE - 1** dated Dec. 2025 and replace with attached **PLANS SHEET NO. ADD. 57 WATERLINE RELOCATION PLAN & PROFILE - 1**.
3. Delete **PLANS SHEET NO. 58 WATERLINE RELOCATION PLAN & PROFILE - 2** dated Dec. 2025 and replace with attached **PLANS SHEET NO. ADD. 58 WATERLINE RELOCATION PLAN & PROFILE - 2**.
4. Delete **PLANS SHEET NO. 59 WATERLINE RELOCATION PLAN & PROFILE - 3** dated Dec. 2025 and replace with attached **PLANS SHEET NO. ADD. 59 WATERLINE RELOCATION PLAN & PROFILE - 3**.
5. Delete **PLANS SHEET NO. 60 WATERLINE RELOCATION PLAN & PROFILE - 4** dated Dec. 2025 and replace with attached **PLANS SHEET NO. ADD. 60 WATERLINE RELOCATION PLAN & PROFILE - 4**.
6. Add and make a part of the PLANS the attached **PLANS SHEET NO. ADD. 62 S-1 TELEPHONE PLAN & PROFILE**.
7. Delete **PLANS SHEET NO. 63 TEMPORARY BRIDGE PLAN** dated Dec. 2025 and replace with attached **PLANS SHEET NO. ADD. 63 TEMPORARY BRIDGE PLAN**.
8. Delete **PLANS SHEET NO. 71 ENLARGED SITE ELECTRICAL PLAN** dated Dec. 2025 and replace with attached **PLANS SHEET NO. ADD. 71 ENLARGED SITE ELECTRICAL PLAN**.
9. Delete **PLANS SHEET NO. 74 ENLARGED SITE LIGHTING PLAN - A** dated Dec. 2025 and replace with attached **PLANS SHEET NO. ADD. 74 ENLARGED SITE LIGHTING PLAN - A**.
10. Delete **PLANS SHEET NO. 82 ROADWAY LIGHT STANDARD DETAIL** dated Dec. 2025 and replace with attached **PLANS SHEET NO. ADD. 82 ROADWAY LIGHT STANDARD DETAIL**.

The following is provided for information.

1. **PRE-BID MEETING MINUTES**

    1. The attached **PRE-BID MEETING MINUTES** are provided for your information.

2. **RESPONSES TO REQUESTS FOR INFORMATION (RFI'S/QUESTIONS)**

   1. The attached **RESPONSES TO REQUESTS FOR INFORMATION** are provided for your information.

3. **GEOTECHNICAL ENGINEERING EXPLORATION REPORT, date June 24, 2024**

   1. The attached **GEOTECHNICAL ENGINEERING EXPLORATION REPORT** is provided for your information.

Please acknowledge receipt of this **ADDENDUM NO. 1** by recording the date of its receipt in the space provided on the **PAGE P-4** of the Proposal.

Henry Kennedy

HENRY KENNEDY
Engineering Program Manager

TABLE OF CONTENTS

DIVISION 300 - BASES		
Section	**Description**	**Pages**
301	Hot Mix Asphalt Base Course	301-1a – 301-2a
304	Aggregate Base Course	304-1a
313	Permeable Separator	313-1a
314	Controlled Low Strength Material (CLSM) For Utilities and Structures	314-1a
315	Non-Woven Geotextile Fabric	315-1a – 315-2a

DIVISION 400 - PAVEMENTS		
Section	**Description**	**Pages**
401	Hot Mix Asphalt Pavement	401-1a – 401-37a
407	Tack Coat	407-1a
411	Portland Cement Concrete Pavement	411-1a
415	Cold Planing of Existing Pavement	415-1a

DIVISION 500 - STRUCTURES		
Section	**Description**	**Pages**
503	Concrete Structures	503-1a – 503-40a
504	Prestressed Concrete Members	504-1a – 504-3a
507	Railings	507-1a

DIVISION 600 - INCIDENTAL CONSTRUCTION		
Section	**Description**	**Pages**
601	Structural Concrete	601-1a – 601-19a
602	Reinforcing Steel	602-1a
603	Culverts and Storm Drains	603-1a
606	Guardrail	606-1a
607	Chain Link Fences and Gates	607-1a
614	Street Survey Monuments	614-1a
621	Invasive Species Management	621-1a – 621-16a

DIVISION 700 - MATERIALS

END OF TABLE OF CONTENTS

Make this Section a Part of the Standard Specifications:

“SECTION 673 – INTERPRETIVE SIGN

673.01 Description. This Section describes fabrication and installation of an interpretive sign.

673.02 Materials. Not applicable.

673.03 Construction. The interpretive sign will include a narrative explanation of the history of the existing Waiaka Bridge, along with graphics such as historical photographs and available original renderings/drawings. The interpretive sign is intended to communicate the significance of the Waiaka Bridge and a discussion of Native Hawaiian history within the area.

Final approved interpretive sign design will be provided to the Contractor for fabrication and installation with this project.

673.04 Measurement. The Engineer will measure the work required for the interpretive sign on a force account basis in accordance with Subsection 109.06 – Force Account Provisions and Compensation and as ordered by the Engineer.

673.05 Payment. The Engineer will pay for the accepted interpretive sign on a force account basis in accordance with Subsection 109.06 – Force Account Provisions and Compensation. Payment will be full compensation for the work prescribed in this section, by the Engineer, and in the contract documents.

The Engineer will pay for the following pay item when included in the proposal schedule:

Pay Item	**Pay Unit**
Interpretive Sign	Force Account

An estimated amount may be allocated in the proposal schedule under “Interpretive Sign”, but the actual amount to be paid will be the sum shown on the accepted force account records, whether this sum be more or less than the estimated amount allocated in the proposal schedule.”

END OF SECTION 673

PROPOSAL SCHEDULE

ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
201.1000	Clearing and Grubbing	6,240	S.Y.	$ ________	$__________
202.0100	Removal of Existing Guardrail	309	L.F.	$ ________	$__________
202.0200	Removal of Existing Wood Fence	246	L.F.	$ ________	$__________
202.0300	Removal of Existing Wire Fence	481	L.F.	$ ________	$__________
202.0400	TMK: (3) 6-5-01:15 Hedge & Fence Relocation	F.A.	F.A.	F.A.	$ 300,000
202.1000	Removal of Existing Bridge and CRM Walls	L.S.	L.S.	L.S.	$__________
202.2000	Hawaiian Telcom Relocation Work	L.S.	L.S.	L.S.	$__________
203.1000	Roadway Excavation	2,010	C.Y.	$ ________	$__________
204.1000	Trench Excavation for Water System	L.S.	L.S.	L.S.	$__________
204.2000	Trench Backfill for Water System	L.S.	L.S.	L.S.	$__________
204.2100	Trench Backfill for Shared Use Path (Recycled Asphalt Pavement Placement and Compaction)	L.S.	L.S.	L.S.	$__________
205.1000	Structure Excavation for Abutments and Wingwalls	L.S.	L.S.	L.S.	$__________
205.1200	Structure Excavation for Concrete Barrier Walls	L.S.	L.S.	L.S.	$__________
205.2000	Structure Backfill for Abutments, Wingwalls, and Concrete Barrier Walls	L.S.	L.S.	L.S.	$__________

PROPOSAL SCHEDULE					
ITEM NO.	**ITEM**	**APPROX. QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
205.3000	CLSM Backfill for Abutments and Wingwalls	L.S.	L.S.	L.S.	$__________
209.1000	Installation, Maintenance, Monitoring, and Removal of BMP	L.S.	L.S.	L.S.	$__________
209.2000	Additional Water Pollution, Dust, and Erosion Control	F.A.	F.A.	F.A.	$_ 150,000
301.1000	Hot Mix Asphalt Base Course	2,720	TON	$ ________	$__________
304.1000	Aggregate Base	1,010	C.Y.	$ ________	$__________
313.1000	Permeable Separator	5,935	S.Y.	$ ________	$__________
315.1000	Non-Woven Geotextile Fabric (Shared Use Path)	370	S.Y.	$ ________	$__________
401.1000	PMA Pavement, Mix No. IV	650	TON	$ ________	$__________
401.2000	HMA Pavement, Mix No. V	270	TON	$ ________	$__________
411.1000	Truck Apron, 10-inch Concrete Pavement	186	C.Y.	$ ________	$__________
415.1000	Cold Planing	262	S.Y.	$ ________	$__________
503.1010	Concrete for Footings, Abutment Walls, Concrete Seats, and Corbels	L.S.	L.S.	L.S.	$__________
503.1020	Concrete for Wingwalls	L.S.	L.S.	L.S.	$__________
503.1030	Concrete for Diaphrams, Bridge Deck, and End Beams	L.S.	L.S.	L.S.	$__________

PROPOSAL SCHEDULE					
ITEM NO.	**ITEM**	**APPROX. QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
503.1040	Concrete for Sidewalks and Splitter Islands	L.S.	L.S.	L.S.	$__________
503.1050	Concrete for Approach Slabs	L.S.	L.S.	L.S.	$__________
503.1060	Concrete for Concrete Barrier Walls	L.S.	L.S.	L.S.	$__________
503.1070	Concrete for Curb and Cradles	L.S.	L.S.	L.S.	$__________
503.1080	Concrete in Water Systems	L.S.	L.S.	L.S.	$__________
504.1000	Prestressed Concrete Beams	17	EACH	$ ________	$__________
504.2000	Post-Tensioning for Abutment Walls	L.S.	L.S.	L.S.	$__________
507.1000	Bridge Concrete Railings and Transition Railings	160	L.F.	$ ________	$__________
507.2000	Concrete End Post Railings	4	EACH	$ ________	$__________
602.1010	Reinforcing Steel for Footings, Abutment Walls, Concrete Seats, and Corbels	L.S.	L.S.	L.S.	$__________
602.1020	Reinforcing Steel for Wingwalls	L.S.	L.S.	L.S.	$__________
602.1030	Reinforcing Steel for Diaphragms, Bridge Deck, and End Beams	L.S.	L.S.	L.S.	$__________
602.1040	Reinforcing Steel for Sidewalks and Splitter Islands	L.S.	L.S.	L.S.	$__________
602.1050	Reinforcing Steel for Approach Slabs	L.S.	L.S.	L.S.	$__________

PROPOSAL SCHEDULE

ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
602.1060	Reinforcing Steel for Concrete Barrier Walls	L.S.	L.S.	L.S.	$__________
602.1070	Reinforcing Steel for Curb and Cradles	L.S.	L.S.	L.S.	$__________
603.1000	Trench Drain	24	L.F.	$ ________	$__________
606.1000	Guardrail Type 3 (31" W-Beam with Standard 8" Offset Block	269	L.F.	$ ________	$__________
606.2000	Guardrail Type 3 (Hawaii MASH Transition)	105	L.F.	$ ________	$__________
606.3000	Terminal Section (MFLEAT or Approved Equal)	1	EACH	$ ________	$__________
606.4000	Terminal Section (MSKT-SP-MGS or Approved Equal)	1	EACH	$ ________	$__________
606.5000	Trailing-End Anchorage System	2	EACH	$ ________	$__________
607.1000	Wooden Fence	295	L.F.	$ ________	$__________
607.2000	Wire Fence	315	L.F.	$ ________	$__________
607.3000	Chain Link Fence	165	L.F.	$ ________	$__________
614.1000	Reconstructing Street Survey Monument	1	EACH	$ ________	$__________
621.1000	Inventory of Invasive Species before Construction	L.S.	L.S.	L.S.	$__________
621.2000	Invasive Species Removal Plan	F.A.	F.A.	F.A.	$ 5,000

PROPOSAL SCHEDULE					
ITEM NO.	**ITEM**	**APPROX. QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
621.3000	Removal of Plants and Animals Established before Physical Construction or Site Work, Post-removal Monitoring	F.A.	F.A.	F.A.	$ 50,000
621.4000	Monitoring of Invasive Species during and after Construction	L.S.	L.S.	L.S.	$__________
621.5000	Post-Construction Inventory Prior to Returning the Site to the State	L.S.	L.S.	L.S.	$__________
622.1000	Roadway and Sign Lighting System	L.S.	L.S.	L.S.	$__________
622.2000	Primary Metering Pole System	L.S.	L.S.	L.S.	$__________
624.1000	Water System A	L.S.	L.S.	L.S.	$__________
624.1100	Water System B	L.S.	L.S.	L.S.	$__________
624.2000	Temporary Water System A	L.S.	L.S.	L.S.	$__________
624.2100	Temporary Water System B	L.S.	L.S.	L.S.	$__________
624.3000	Type X Meter Box	1	EACH	$ ________	$__________
626.1000	Adjusting SIC Manhole Frame and Cover	1	EACH	$ ________	$__________
626.1100	Adjusting (Water) Standard Valve Box	4	EACH	$ ________	$__________

PROPOSAL SCHEDULE					
ITEM NO.	**ITEM**	**APPROX. QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
629.1000	Yellow, 4-Inch Pavement Striping (Thermoplastic Extrusion)	200	L.F.	$ ________	$__________
629.2000	White, 6-Inch Pavement Striping (Thermoplastic Extrusion)	1,800	L.F.	$ ________	$__________
629.3000	White, 12-Inch Pavement Striping (Thermoplastic Extrusion)	120	L.F.	$ ________	$__________
629.4000	Yellow, Double 4-Inch Pavement Striping (Thermoplastic Extrusion)	1,050	L.F.	$ ________	$__________
629.5000	Crosswalk Marking (Thermoplastic Extrusion)	4	LANE	$ ________	$__________
629.5100	Pavement Symbol (Thermoplastic Extrusion)	4	EACH	$ ________	$__________
629.6000	Yield Line (Thermoplastic Extrusion)	3	EACH	$ ________	$__________
629.7000	Type C Pavement Marker	55	EACH	$ ________	$__________
629.7100	Type D Pavement Marker	42	EACH	$ ________	$__________
629.7200	Type F Pavement Marker	1	EACH	$ ________	$__________
629.7300	Type H Pavement Marker	30	EACH	$ ________	$__________
631.1000	Regulatory Sign (10 Square Feet or Less) with Post	8	EACH	$ ________	$__________
631.1100	Warning Sign (10 Square Feet or Less) with Post	7	EACH	$ ________	$__________

PROPOSAL SCHEDULE

ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
631.2000	Relocation of Existing Sign	12	EACH	$ ________	$__________
638.1000	Curb, Type 2D	95	L.F.	$ ________	$__________
638.2000	Curb, Type 2A Modified	551	L.F.	$ ________	$__________
641.1000	Hydro-Mulch Seeding	10,275	S.Y.	$ ________	$__________
643.1000	Maintenance of Existing Landscape Areas	F.A.	F.A.	F.A.	$ 50,000
645.1000	Traffic Control	L.S.	L.S.	L.S.	$__________
645.2000	Additional Police Officers, Additional Traffic Control Devices, and Advertisement	F.A.	F.A.	F.A.	$ 100,000
648.1000	Field-Posted Drawings	L.S.	L.S.	L.S.	$__________
650.1000	Curb Ramp, Type C	2	EACH	$ ________	$__________
656.1000	Drilling Holes and Installing Dowel Reinforcing Bars for Splitter Islands and ARV Cage	380	EACH	$ ________	$__________
657.1000	EVC System	L.S.	L.S.	L.S.	$__________
658.1000	Archaeological Monitoring	F.A.	F.A.	F.A.	$ 200,000
659.1000	Qualified Arborist, Root Barrier Installation and Tree and Root Pruning	F.A.	F.A.	F.A.	$ 50,000
660.0100	Furnishing Probing and Grouting Equipment	L.S.	L.S.	L.S.	$__________

PROPOSAL SCHEDULE

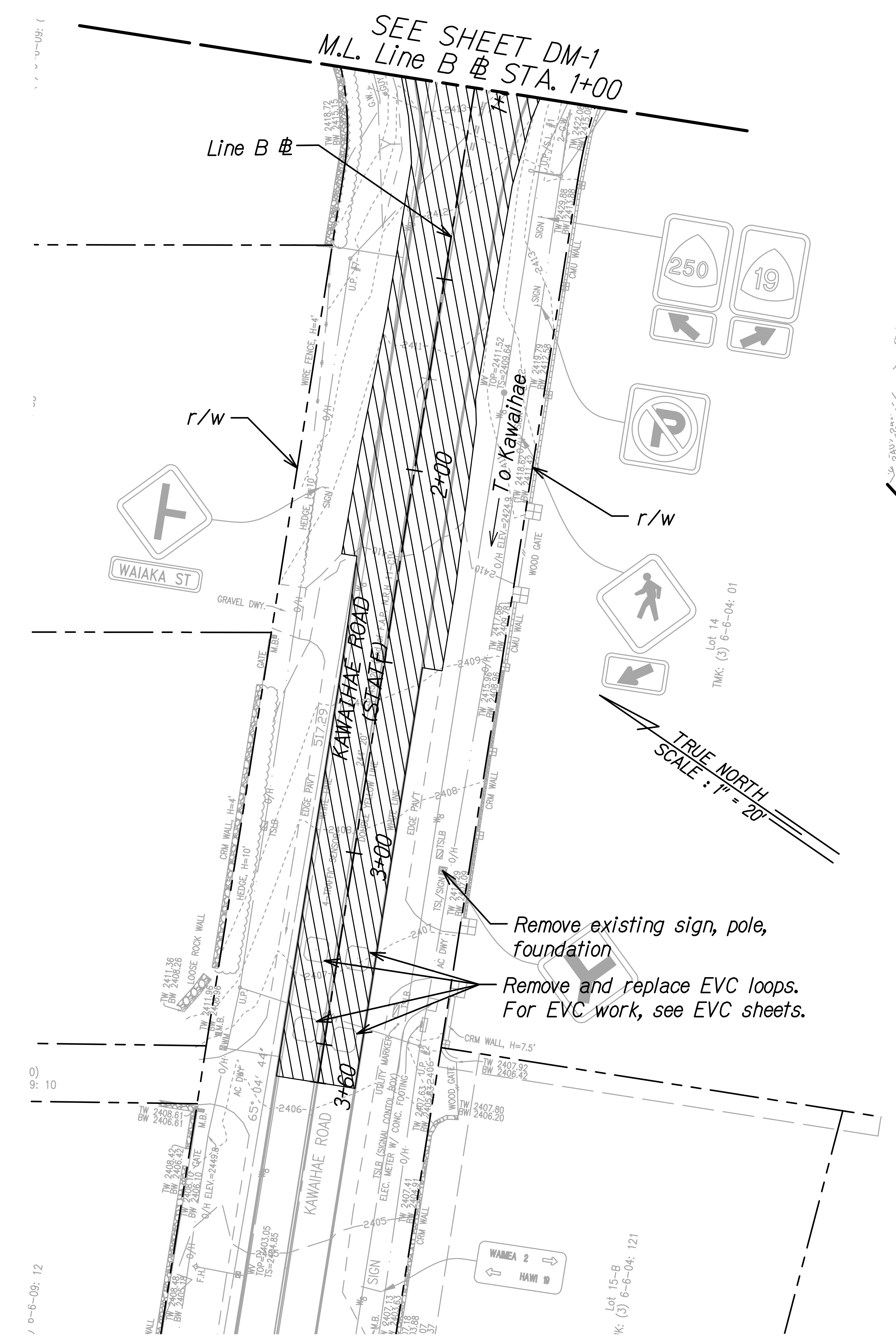
ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
660.0200	Probe Holes	190	L.F.	$ ________	$__________
660.0300	Grouting of Probe Holes	13	C.F.	$ ________	$__________
660.0400	Additional Probe Holes	F.A.	F.A.	F.A.	$ 32,000
660.0500	Grouting of Additional Probe Holes	F.A.	F.A.	F.A.	$ 16,000
661.1000	Temporary Bridge Design and Construction	L.S.	L.S.	L.S.	$__________
671.1000	Protection of Endangered Species	F.A.	F.A.	F.A.	$ 25,000
673.1000	Interpretive Sign	F.A.	F.A.	F.A.	$ 25,000
690.1000	Removal and Disposal of Lead-Based Paint	F.A.	F.A.	F.A.	$ 20,000
694.1000	Longitudinal Channelizing Curb System with 36" Tall Reflectorized Uprights	L.S.	L.S.	L.S.	$__________
695.1000	Public Education Materials or Services	F.A.	F.A.	F.A.	$ 20,000
696.1000	Field Office Trailer (Not to Exceed $32,000)	L.S.	L.S.	L.S.	$__________
696.2000	Maintenance of Trailers	F.A.	F.A.	F.A.	$ 50,000
699.1000	Mobilization (Not to Exceed 6 Percent of the Sum of All Items Excluding Bid Price of this Item)	L.S.	L.S.	L.S.	$__________

PROPOSAL SCHEDULE					
ITEM NO.	**ITEM**	**APPROX. QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**

Total Amount for Comparison of Bids ………………………………………………………………………… $ ___________

NOTE: Bidders shall complete all unit prices and amounts. Failure to do so shall be grounds for rejection of bid.

FED. ROAD DIST. NO.	STATE	FEDERAL AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-019-1(093)	2026	ADD.12	198



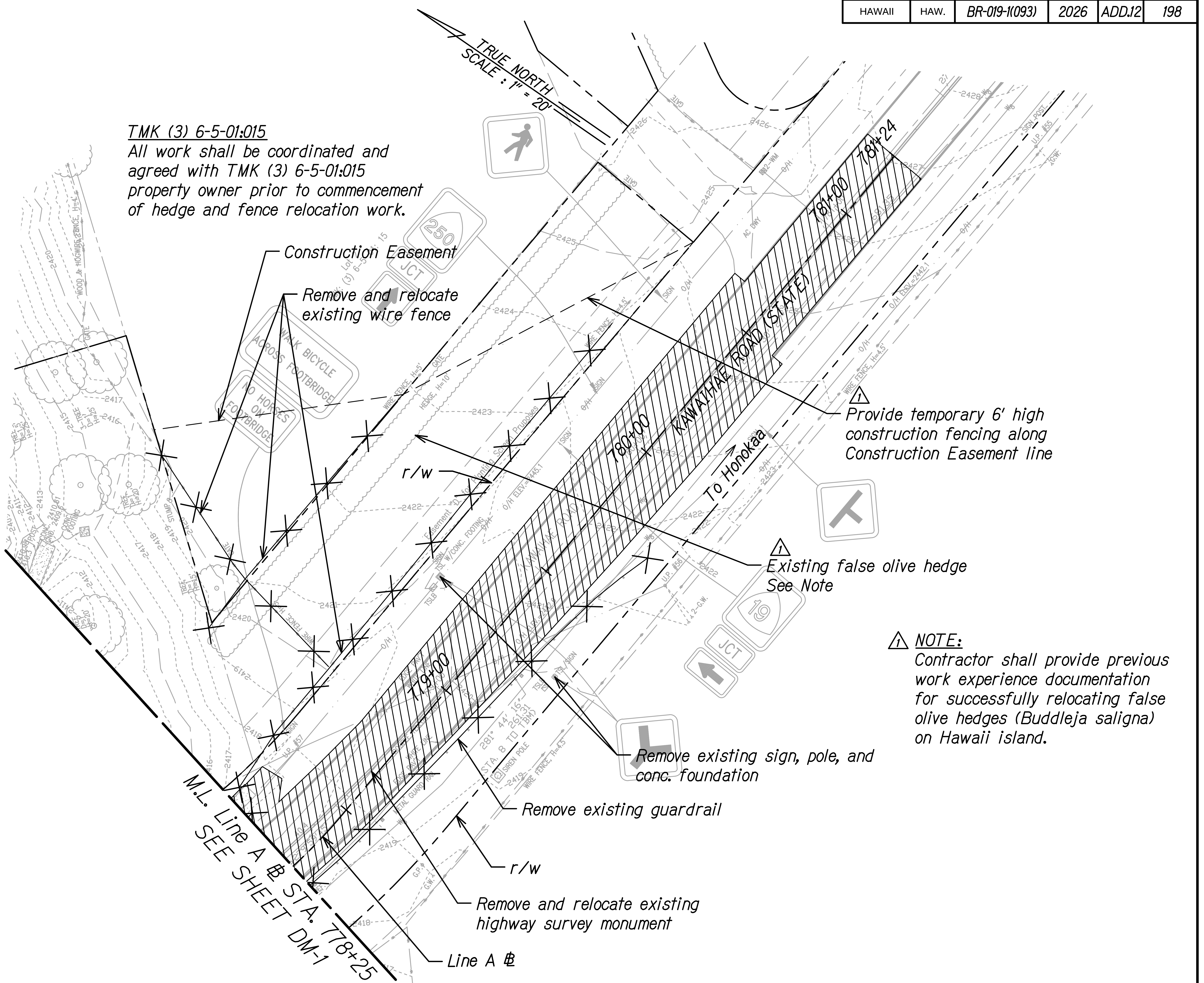
Line B ℄

r/w

r/w

Remove existing sign, pole, foundation

Remove and replace EVC loops. For EVC work, see EVC sheets.



TMK (3) 6-5-01:015
All work shall be coordinated and agreed with TMK (3) 6-5-01:015 property owner prior to commencement of hedge and fence relocation work.

Construction Easement

Remove and relocate existing wire fence

r/w

△ Provide temporary 6' high construction fencing along Construction Easement line

△ Existing false olive hedge See Note

Remove existing sign, pole, and conc. foundation

Remove existing guardrail

r/w

Remove and relocate existing highway survey monument

Line A ℄

△ NOTE:
Contractor shall provide previous work experience documentation for successfully relocating false olive hedges (Buddleja saligna) on Hawaii island.

▨ Limits of Demolition

—×—×— Remove and Dispose Chain Link Fence, Wood Fence, Wire Fence, or Guardrail

GRAPHIC SCALE
1" = 20' 20 0 20 40
SCALE IN FEET

	Date	Revision
△	2/5/26	Note & callouts added

DARIN N. CHINEN
No. 7977-C

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.
SIGNATURE 04/30/26 EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

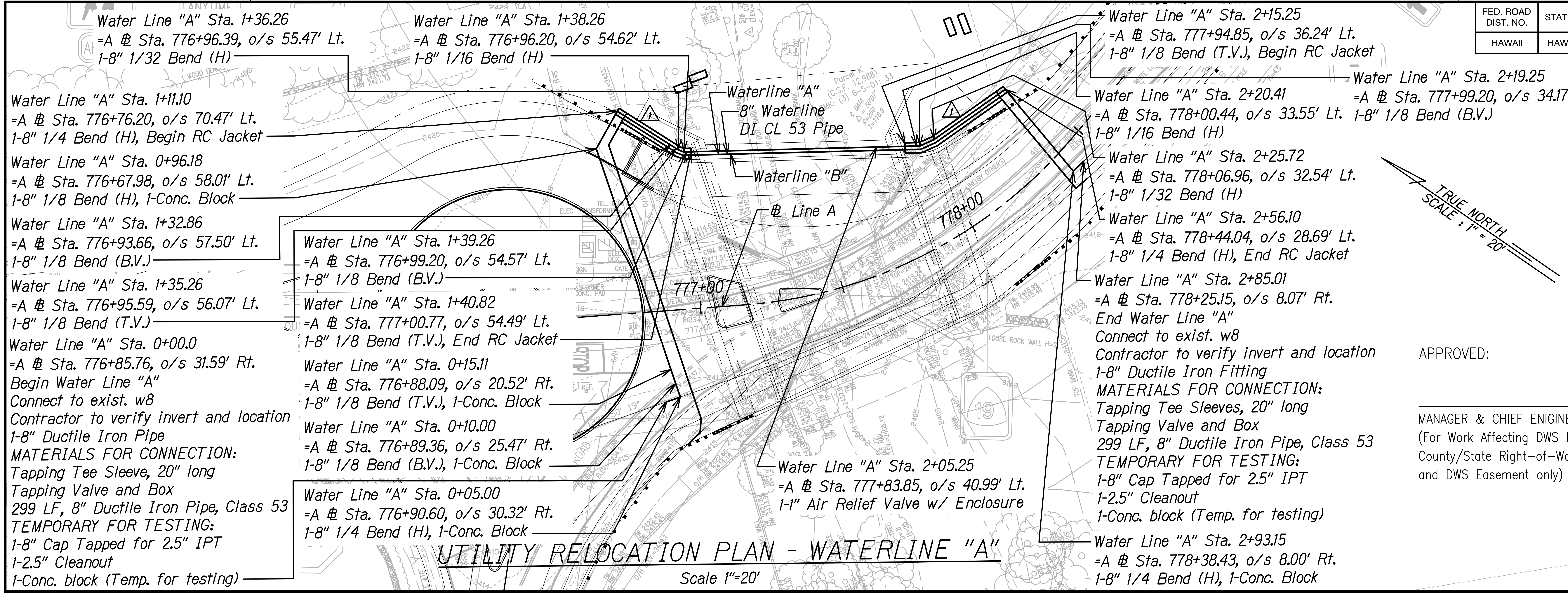
DEMOLITION PLAN

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
Federal-Aid Project No. BR-019-1(093)
Scale: 1" = 20' Date: Dec. 2025

SHEET No. DM-2 OF 2 SHEETS

ORIGINAL PLAN
SURVEY PLOTTED BY
DRAWN BY
TRACED BY
DESIGNED BY
QUANTITIES BY
CHECKED BY
NOTE BOOK No.
DATE

FED. ROAD DIST. NO.	STATE	FEDERAL AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-019-1(093)	2026	ADD. 57	198



Water Line "A" Sta. 1+36.26
=A ℄ Sta. 776+96.39, o/s 55.47' Lt.
1-8" 1/32 Bend (H)

Water Line "A" Sta. 1+38.26
=A ℄ Sta. 776+96.20, o/s 54.62' Lt.
1-8" 1/16 Bend (H)

Water Line "A" Sta. 1+11.10
=A ℄ Sta. 776+76.20, o/s 70.47' Lt.
1-8" 1/4 Bend (H), Begin RC Jacket

Water Line "A" Sta. 0+96.18
=A ℄ Sta. 776+67.98, o/s 58.01' Lt.
1-8" 1/8 Bend (H), 1-Conc. Block

Water Line "A" Sta. 1+32.86
=A ℄ Sta. 776+93.66, o/s 57.50' Lt.
1-8" 1/8 Bend (B.V.)

Water Line "A" Sta. 1+35.26
=A ℄ Sta. 776+95.59, o/s 56.07' Lt.
1-8" 1/8 Bend (T.V.)

Water Line "A" Sta. 0+00.0
=A ℄ Sta. 776+85.76, o/s 31.59' Rt.
Begin Water Line "A"
Connect to exist. w8
Contractor to verify invert and location
1-8" Ductile Iron Pipe
MATERIALS FOR CONNECTION:
Tapping Tee Sleeve, 20" long
Tapping Valve and Box
299 LF, 8" Ductile Iron Pipe, Class 53
TEMPORARY FOR TESTING:
1-8" Cap Tapped for 2.5" IPT
1-2.5" Cleanout
1-Conc. block (Temp. for testing)

Water Line "A" Sta. 1+39.26
=A ℄ Sta. 776+99.20, o/s 54.57' Lt.
1-8" 1/8 Bend (B.V.)

Water Line "A" Sta. 1+40.82
=A ℄ Sta. 777+00.77, o/s 54.49' Lt.
1-8" 1/8 Bend (T.V.), End RC Jacket

Water Line "A" Sta. 0+15.11
=A ℄ Sta. 776+88.09, o/s 20.52' Rt.
1-8" 1/8 Bend (T.V.), 1-Conc. Block

Water Line "A" Sta. 0+10.00
=A ℄ Sta. 776+89.36, o/s 25.47' Rt.
1-8" 1/8 Bend (B.V.), 1-Conc. Block

Water Line "A" Sta. 0+05.00
=A ℄ Sta. 776+90.60, o/s 30.32' Rt.
1-8" 1/4 Bend (H), 1-Conc. Block

Waterline "A"
8" Waterline
DI CL 53 Pipe

Waterline "B"

℄ Line A

Water Line "A" Sta. 2+05.25
=A ℄ Sta. 777+83.85, o/s 40.99' Lt.
1-1" Air Relief Valve w/ Enclosure

Water Line "A" Sta. 2+15.25
=A ℄ Sta. 777+94.85, o/s 36.24' Lt.
1-8" 1/8 Bend (T.V.), Begin RC Jacket

Water Line "A" Sta. 2+19.25
=A ℄ Sta. 777+99.20, o/s 34.17' Lt.
1-8" 1/8 Bend (B.V.)

Water Line "A" Sta. 2+20.41
=A ℄ Sta. 778+00.44, o/s 33.55' Lt.
1-8" 1/16 Bend (H)

Water Line "A" Sta. 2+25.72
=A ℄ Sta. 778+06.96, o/s 32.54' Lt.
1-8" 1/32 Bend (H)

Water Line "A" Sta. 2+56.10
=A ℄ Sta. 778+44.04, o/s 28.69' Lt.
1-8" 1/4 Bend (H), End RC Jacket

Water Line "A" Sta. 2+85.01
=A ℄ Sta. 778+25.15, o/s 8.07' Rt.
End Water Line "A"
Connect to exist. w8
Contractor to verify invert and location
1-8" Ductile Iron Fitting
MATERIALS FOR CONNECTION:
Tapping Tee Sleeves, 20" long
Tapping Valve and Box
299 LF, 8" Ductile Iron Pipe, Class 53
TEMPORARY FOR TESTING:
1-8" Cap Tapped for 2.5" IPT
1-2.5" Cleanout
1-Conc. block (Temp. for testing)

Water Line "A" Sta. 2+93.15
=A ℄ Sta. 778+38.43, o/s 8.00' Rt.
1-8" 1/4 Bend (H), 1-Conc. Block

TRUE NORTH
SCALE : 1" = 20'

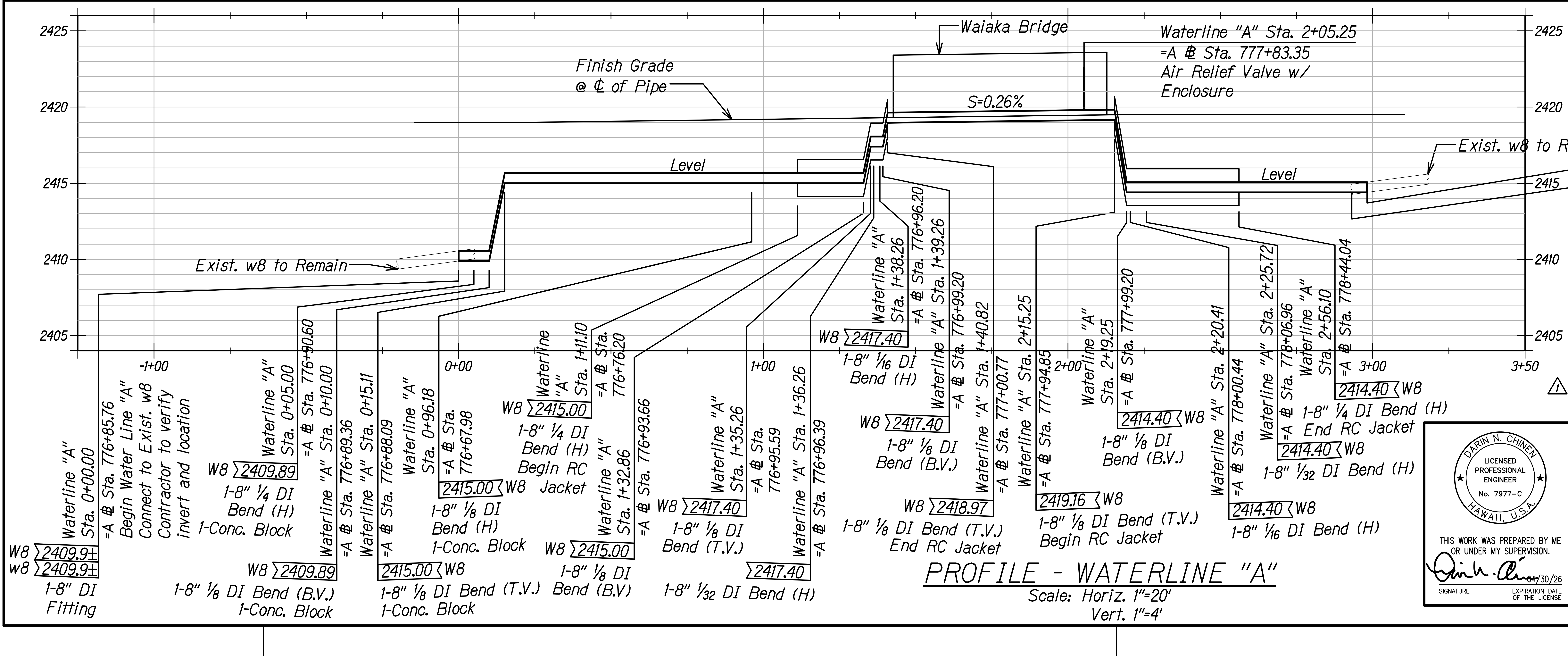
UTILITY RELOCATION PLAN - WATERLINE "A"

Scale 1"=20'

APPROVED:

MANAGER & CHIEF ENIGINEER, DWS
(For Work Affecting DWS Facilities in
County/State Right-of-Way
and DWS Easement only)

DATE



Waiaka Bridge

Finish Grade
@ ℄ of Pipe

Waterline "A" Sta. 2+05.25
=A ℄ Sta. 777+83.35
Air Relief Valve w/
Enclosure

Exist. w8 to Remain

Exist. w8 to Remain

Waterline "A"
Sta. 0+00.00
=A ℄ Sta. 776+85.76
Begin Water Line "A"
Connect to Exist. w8
Contractor to verify
invert and location
W8 2409.9±
w8 2409.9±
1-8" DI
Fitting

Waterline "A"
Sta. 0+05.00
=A ℄ Sta. 776+90.60
W8 2409.89
1-8" ¼ DI
Bend (H)
1-Conc. Block

Waterline "A" Sta. 0+10.00
=A ℄ Sta. 776+89.36
W8 2409.89
1-8" ⅛ DI Bend (B.V.)
1-Conc. Block

Waterline "A" Sta. 0+15.11
=A ℄ Sta. 776+88.09
2415.00 W8
1-8" ⅛ DI Bend (T.V.)
1-Conc. Block

Waterline "A"
Sta. 0+96.18
=A ℄ Sta.
776+67.98
2415.00 W8
1-8" ⅛ DI
Bend (H)
1-Conc. Block

Waterline
"A"
Sta. 1+11.10
=A ℄ Sta.
776+76.20
W8 2415.00
1-8" ¼ DI
Bend (H)
Begin RC
Jacket

Waterline "A"
Sta. 1+32.86
=A ℄ Sta. 776+93.66
W8 2415.00
1-8" ⅛ DI
Bend (B.V)

Waterline "A"
Sta. 1+35.26
=A ℄ Sta.
776+95.59
W8 2417.40
1-8" ⅛ DI
Bend (T.V.)

Waterline "A" Sta. 1+36.26
=A ℄ Sta. 776+96.39
2417.40
1-8" 1/32 DI Bend (H)

Waterline "A"
Sta. 1+38.26
=A ℄ Sta. 776+96.20
W8 2417.40
1-8" 1/16 DI
Bend (H)

Waterline "A" Sta. 1+39.26
=A ℄ Sta. 776+99.20
W8 2417.40
1-8" ⅛ DI
Bend (B.V.)

Waterline "A" Sta. 1+40.82
=A ℄ Sta. 777+00.77
W8 2418.97
1-8" ⅛ DI Bend (T.V.)
End RC Jacket

Waterline "A" Sta. 2+15.25
=A ℄ Sta. 777+94.85
2419.16 W8
1-8" ⅛ DI Bend (T.V.)
Begin RC Jacket

Waterline "A"
Sta. 2+19.25
=A ℄ Sta. 777+99.20
2414.40 W8
1-8" ⅛ DI
Bend (B.V.)

Waterline "A" Sta. 2+20.41
=A ℄ Sta. 778+00.44
2414.40 W8
1-8" 1/16 DI Bend (H)

Waterline "A" Sta. 2+25.72
=A ℄ Sta. 778+06.96
2414.40 W8
1-8" 1/32 DI Bend (H)

Waterline "A"
Sta. 2+56.10
=A ℄ Sta. 778+44.04
2414.40 W8
1-8" ¼ DI Bend (H)
End RC Jacket

Waterline "A"
Sta. 2+93.15
=A ℄ Sta. 778+38.43
2414.40 W8
1-8" ¼ DI Bend (H)
1-Conc. Block

Waterline "A"
Sta. 2+98.15
=A ℄ Sta. 778+43.19
End Water Line "A"
Connect to Exist. w8
Contractor to verify
invert and location
2414.4± W8
2414.4± w8
1-8" DI Fitting

PROFILE - WATERLINE "A"

Scale: Horiz. 1"=20'
Vert. 1"=4'

	Date	Revision
1	2/5/26	Revised Note

DARIN N. CHINEN
LICENSED PROFESSIONAL ENGINEER
No. 7977-C
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME
OR UNDER MY SUPERVISION.

SIGNATURE
04/30/26
EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

WATERLINE RELOCATION
PLAN & PROFILE - 1

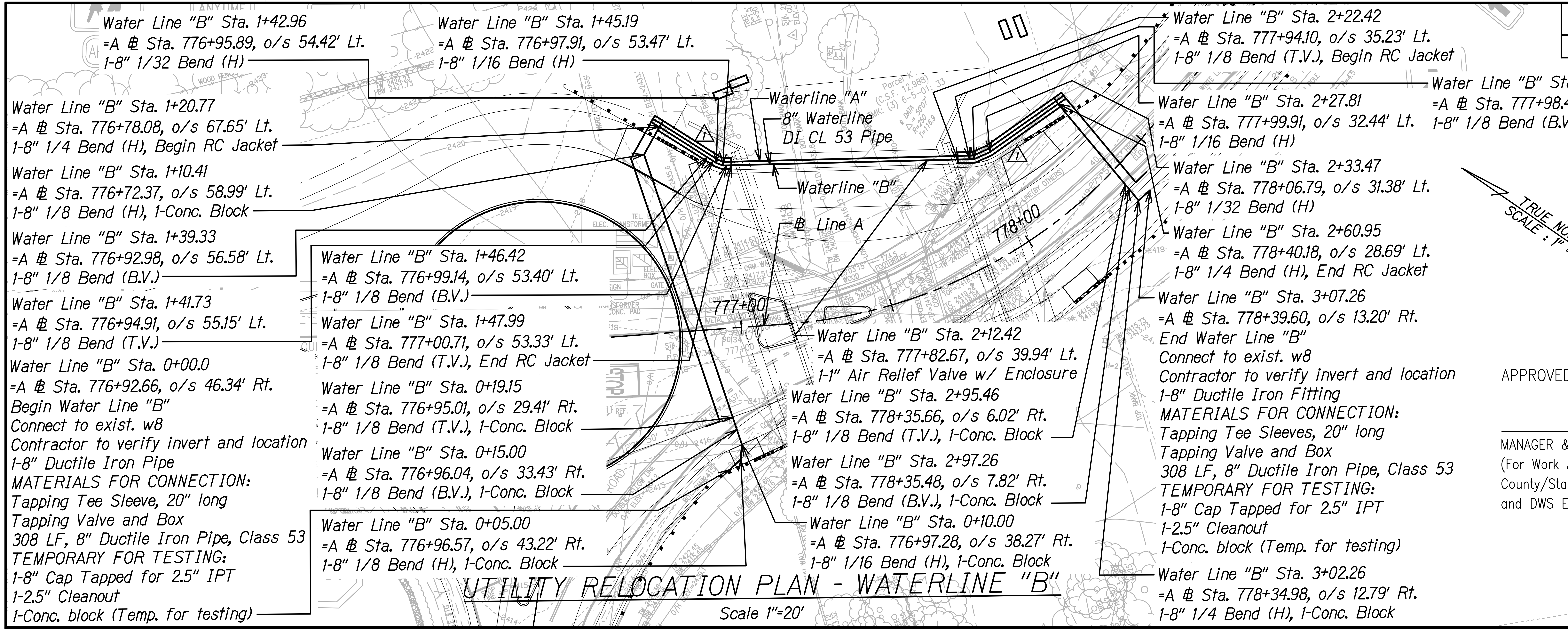
KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
Federal-Aid Project No. BR-019-1(093)

Scale: As Shown
Date: Dec. 2025

SHEET No. U-1 OF 6 SHEETS

ORIGINAL PLAN	SURVEY PLOTTED BY	DATE
	DRAWN BY	
NOTE BOOK	TRACED BY	
	DESIGNED BY	
No.	QUANTITIES BY	
	CHECKED BY	

FED. ROAD DIST. NO.	STATE	FEDERAL AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-019-1(093)	2026	ADD. 58	198



Water Line "B" Sta. 1+42.96
=A Ⓑ Sta. 776+95.89, o/s 54.42' Lt.
1-8" 1/32 Bend (H)

Water Line "B" Sta. 1+45.19
=A Ⓑ Sta. 776+97.91, o/s 53.47' Lt.
1-8" 1/16 Bend (H)

Water Line "B" Sta. 1+20.77
=A Ⓑ Sta. 776+78.08, o/s 67.65' Lt.
1-8" 1/4 Bend (H), Begin RC Jacket

Water Line "B" Sta. 1+10.41
=A Ⓑ Sta. 776+72.37, o/s 58.99' Lt.
1-8" 1/8 Bend (H), 1-Conc. Block

Water Line "B" Sta. 1+39.33
=A Ⓑ Sta. 776+92.98, o/s 56.58' Lt.
1-8" 1/8 Bend (B.V.)

Water Line "B" Sta. 1+41.73
=A Ⓑ Sta. 776+94.91, o/s 55.15' Lt.
1-8" 1/8 Bend (T.V.)

Water Line "B" Sta. 0+00.0
=A Ⓑ Sta. 776+92.66, o/s 46.34' Rt.
Begin Water Line "B"
Connect to exist. w8
Contractor to verify invert and location
1-8" Ductile Iron Pipe
MATERIALS FOR CONNECTION:
Tapping Tee Sleeve, 20" long
Tapping Valve and Box
308 LF, 8" Ductile Iron Pipe, Class 53
TEMPORARY FOR TESTING:
1-8" Cap Tapped for 2.5" IPT
1-2.5" Cleanout
1-Conc. block (Temp. for testing)

Water Line "B" Sta. 1+46.42
=A Ⓑ Sta. 776+99.14, o/s 53.40' Lt.
1-8" 1/8 Bend (B.V.)

Water Line "B" Sta. 1+47.99
=A Ⓑ Sta. 777+00.71, o/s 53.33' Lt.
1-8" 1/8 Bend (T.V.), End RC Jacket

Water Line "B" Sta. 0+19.15
=A Ⓑ Sta. 776+95.01, o/s 29.41' Rt.
1-8" 1/8 Bend (T.V.), 1-Conc. Block

Water Line "B" Sta. 0+15.00
=A Ⓑ Sta. 776+96.04, o/s 33.43' Rt.
1-8" 1/8 Bend (B.V.), 1-Conc. Block

Water Line "B" Sta. 0+05.00
=A Ⓑ Sta. 776+96.57, o/s 43.22' Rt.
1-8" 1/8 Bend (H), 1-Conc. Block

Water Line "B" Sta. 2+12.42
=A Ⓑ Sta. 777+82.67, o/s 39.94' Lt.
1-1" Air Relief Valve w/ Enclosure

Water Line "B" Sta. 2+95.46
=A Ⓑ Sta. 778+35.66, o/s 6.02' Rt.
1-8" 1/8 Bend (T.V.), 1-Conc. Block

Water Line "B" Sta. 2+97.26
=A Ⓑ Sta. 778+35.48, o/s 7.82' Rt.
1-8" 1/8 Bend (B.V.), 1-Conc. Block

Water Line "B" Sta. 0+10.00
=A Ⓑ Sta. 776+97.28, o/s 38.27' Rt.
1-8" 1/16 Bend (H), 1-Conc. Block

Water Line "B" Sta. 2+22.42
=A Ⓑ Sta. 777+94.10, o/s 35.23' Lt.
1-8" 1/8 Bend (T.V.), Begin RC Jacket

Water Line "B" Sta. 2+26.42
=A Ⓑ Sta. 777+98.43, o/s 33.18' Lt.
1-8" 1/8 Bend (B.V.)

Water Line "B" Sta. 2+27.81
=A Ⓑ Sta. 777+99.91, o/s 32.44' Lt.
1-8" 1/16 Bend (H)

Water Line "B" Sta. 2+33.47
=A Ⓑ Sta. 778+06.79, o/s 31.38' Lt.
1-8" 1/32 Bend (H)

Water Line "B" Sta. 2+60.95
=A Ⓑ Sta. 778+40.18, o/s 28.69' Lt.
1-8" 1/4 Bend (H), End RC Jacket

Water Line "B" Sta. 3+07.26
=A Ⓑ Sta. 778+39.60, o/s 13.20' Rt.
End Water Line "B"
Connect to exist. w8
Contractor to verify invert and location
1-8" Ductile Iron Fitting
MATERIALS FOR CONNECTION:
Tapping Tee Sleeves, 20" long
Tapping Valve and Box
308 LF, 8" Ductile Iron Pipe, Class 53
TEMPORARY FOR TESTING:
1-8" Cap Tapped for 2.5" IPT
1-2.5" Cleanout
1-Conc. block (Temp. for testing)

Water Line "B" Sta. 3+02.26
=A Ⓑ Sta. 778+34.98, o/s 12.79' Rt.
1-8" 1/4 Bend (H), 1-Conc. Block

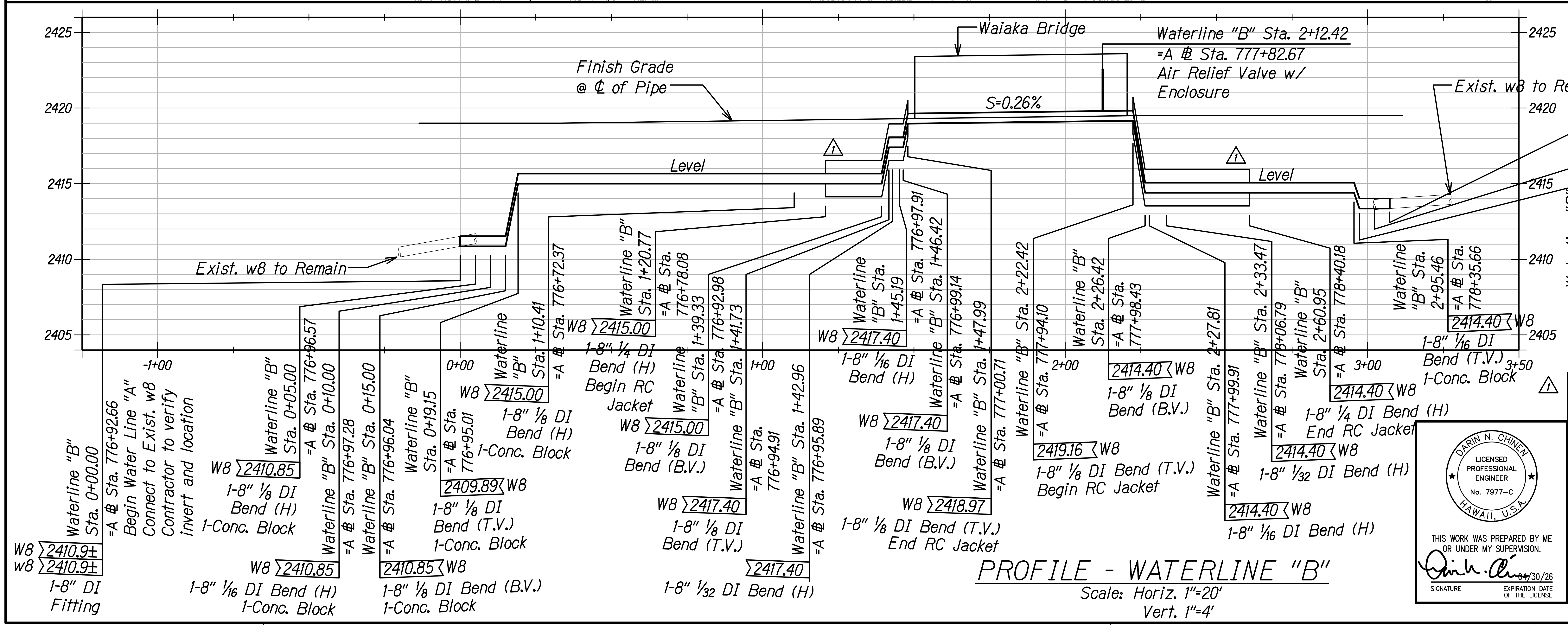
UTILITY RELOCATION PLAN - WATERLINE "B"

Scale 1"=20'

APPROVED:

MANAGER & CHIEF ENIGINEER, DWS
(For Work Affecting DWS Facilities in
County/State Right-of-Way
and DWS Easement only)

DATE



Waterline "B" Sta. 2+12.42
=A Ⓑ Sta. 777+82.67
Air Relief Valve w/
Enclosure

Waterline "B" Sta. 0+00.00
=A Ⓑ Sta. 776+92.66
Begin Water Line "A"
Connect to Exist. w8
Contractor to verify
invert and location
W8 2410.9±
w8 2410.9±
1-8" DI
Fitting

Waterline "B" Sta. 0+05.00
=A Ⓑ Sta. 776+96.57
W8 2410.85
1-8" 1/8 DI
Bend (H)
1-Conc. Block

Waterline "B" Sta. 0+10.00
=A Ⓑ Sta. 776+97.28
W8 2410.85
1-8" 1/16 DI Bend (H)
1-Conc. Block

Waterline "B" Sta. 0+15.00
=A Ⓑ Sta. 776+96.04
2410.85 W8
1-8" 1/8 DI Bend (B.V.)
1-Conc. Block

Waterline "B" Sta. 0+19.15
=A Ⓑ Sta. 776+95.01
2409.89 W8
1-8" 1/8 DI
Bend (T.V.)
1-Conc. Block

Waterline "B" Sta. 1+10.41
=A Ⓑ Sta. 776+72.37
W8 2415.00
1-8" 1/8 DI
Bend (H)
1-Conc. Block

Waterline "B" Sta. 1+20.77
=A Ⓑ Sta. 776+78.08
W8 2415.00
1-8" 1/4 DI
Bend (H)
Begin RC
Jacket

Waterline "B" Sta. 1+39.33
=A Ⓑ Sta. 776+92.98
W8 2415.00
1-8" 1/8 DI
Bend (B.V.)

Waterline "B" Sta. 1+41.73
=A Ⓑ Sta. 776+94.91
W8 2417.40
1-8" 1/8 DI
Bend (T.V.)

Waterline "B" Sta. 1+42.96
=A Ⓑ Sta. 776+95.89
2417.40
1-8" 1/32 DI Bend (H)

Waterline "B" Sta. 1+45.19
=A Ⓑ Sta. 776+97.91
W8 2417.40
1-8" 1/16 DI
Bend (H)

Waterline "B" Sta. 1+46.42
=A Ⓑ Sta. 776+99.14
W8 2417.40
1-8" 1/8 DI
Bend (B.V.)

Waterline "B" Sta. 1+47.99
=A Ⓑ Sta. 777+00.71
W8 2418.97
1-8" 1/8 DI Bend (T.V.)
End RC Jacket

Waterline "B" Sta. 2+22.42
=A Ⓑ Sta. 777+94.10
2419.16 W8
1-8" 1/8 DI Bend (T.V.)
Begin RC Jacket

Waterline "B" Sta. 2+26.42
=A Ⓑ Sta. 777+98.43
2414.40 W8
1-8" 1/8 DI
Bend (B.V.)

Waterline "B" Sta. 2+27.81
=A Ⓑ Sta. 777+99.91
2414.40 W8
1-8" 1/16 DI Bend (H)

Waterline "B" Sta. 2+33.47
=A Ⓑ Sta. 778+06.79
2414.40 W8
1-8" 1/32 DI Bend (H)

Waterline "B" Sta. 2+60.95
=A Ⓑ Sta. 778+40.18
2414.40 W8
1-8" 1/4 DI Bend (H)
End RC Jacket

Waterline "B" Sta. 2+95.46
=A Ⓑ Sta. 778+35.66
2414.40 W8
1-8" 1/16 DI
Bend (T.V.)
1-Conc. Block

Waterline "B" Sta. 2+97.26
=A Ⓑ Sta. 778+35.48
2413.35 W8
1-8" 1/16 DI
Bend (B.V.)
1-Conc. Block

Waterline "B" Sta. 3+02.26
=A Ⓑ Sta. 778+34.98
2413.35 W8
1-8" 1/4 DI Bend (H)
1-Conc. Block

Waterline "B" Sta. 3+07.26
=A Ⓑ Sta. 778+39.60
End Water Line "B"
Connect to Exist. w8
Contractor to verify
invert and location
2413.4± W8
2413.4± w8
1-8" DI Fitting

PROFILE - WATERLINE "B"

Scale: Horiz. 1"=20'
Vert. 1"=4'

1	2/5/26	Revised Note
	Date	Revision

DARIN N. CHINEN
LICENSED PROFESSIONAL ENGINEER
No. 7977-C
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.

SIGNATURE 4/30/26 EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

WATERLINE RELOCATION
PLAN & PROFILE - 2

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
Federal-Aid Project No. BR-019-1(093)

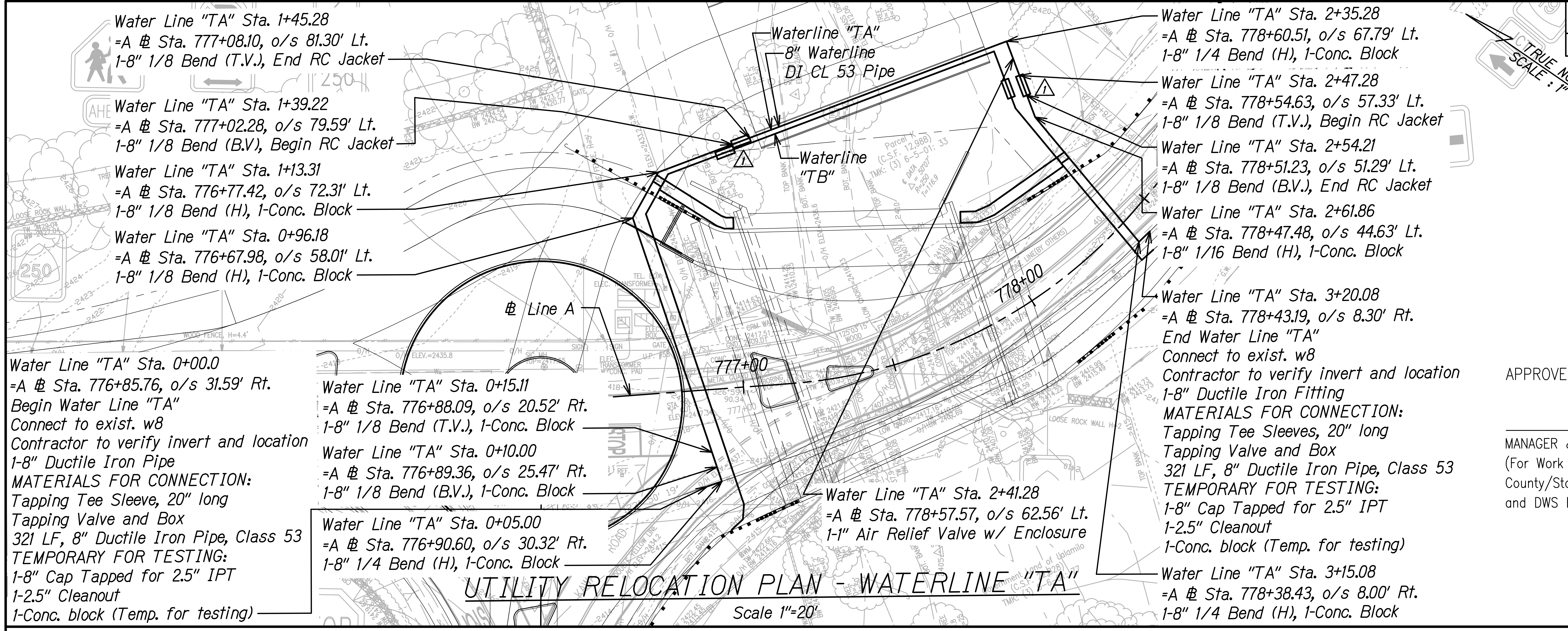
Scale: As Shown   Date: Dec. 2025

SHEET No. U-2 OF 6 SHEETS

ADD. 58

ORIGINAL PLAN	SURVEY PLOTTED BY
	DRAWN BY
	TRACED BY
NOTE BOOK	DESIGNED BY
	QUANTITIES BY
No.	CHECKED BY

FED. ROAD DIST. NO.	STATE	FEDERAL AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-019-1(093)	2026	ADD. 59	198



Water Line "TA" Sta. 1+45.28
=A ℄ Sta. 777+08.10, o/s 81.30' Lt.
1-8" 1/8 Bend (T.V.), End RC Jacket

Water Line "TA" Sta. 1+39.22
=A ℄ Sta. 777+02.28, o/s 79.59' Lt.
1-8" 1/8 Bend (B.V.), Begin RC Jacket

Water Line "TA" Sta. 1+13.31
=A ℄ Sta. 776+77.42, o/s 72.31' Lt.
1-8" 1/8 Bend (H), 1-Conc. Block

Water Line "TA" Sta. 0+96.18
=A ℄ Sta. 776+67.98, o/s 58.01' Lt.
1-8" 1/8 Bend (H), 1-Conc. Block

Water Line "TA" Sta. 0+00.0
=A ℄ Sta. 776+85.76, o/s 31.59' Rt.
Begin Water Line "TA"
Connect to exist. w8
Contractor to verify invert and location
1-8" Ductile Iron Pipe
MATERIALS FOR CONNECTION:
Tapping Tee Sleeve, 20" long
Tapping Valve and Box
321 LF, 8" Ductile Iron Pipe, Class 53
TEMPORARY FOR TESTING:
1-8" Cap Tapped for 2.5" IPT
1-2.5" Cleanout
1-Conc. block (Temp. for testing)

Water Line "TA" Sta. 0+15.11
=A ℄ Sta. 776+88.09, o/s 20.52' Rt.
1-8" 1/8 Bend (T.V.), 1-Conc. Block

Water Line "TA" Sta. 0+10.00
=A ℄ Sta. 776+89.36, o/s 25.47' Rt.
1-8" 1/8 Bend (B.V.), 1-Conc. Block

Water Line "TA" Sta. 0+05.00
=A ℄ Sta. 776+90.60, o/s 30.32' Rt.
1-8" 1/4 Bend (H), 1-Conc. Block

Water Line "TA" Sta. 2+41.28
=A ℄ Sta. 778+57.57, o/s 62.56' Lt.
1-1" Air Relief Valve w/ Enclosure

Water Line "TA" Sta. 2+35.28
=A ℄ Sta. 778+60.51, o/s 67.79' Lt.
1-8" 1/4 Bend (H), 1-Conc. Block

Water Line "TA" Sta. 2+47.28
=A ℄ Sta. 778+54.63, o/s 57.33' Lt.
1-8" 1/8 Bend (T.V.), Begin RC Jacket

Water Line "TA" Sta. 2+54.21
=A ℄ Sta. 778+51.23, o/s 51.29' Lt.
1-8" 1/8 Bend (B.V.), End RC Jacket

Water Line "TA" Sta. 2+61.86
=A ℄ Sta. 778+47.48, o/s 44.63' Lt.
1-8" 1/16 Bend (H), 1-Conc. Block

Water Line "TA" Sta. 3+20.08
=A ℄ Sta. 778+43.19, o/s 8.30' Rt.
End Water Line "TA"
Connect to exist. w8
Contractor to verify invert and location
1-8" Ductile Iron Fitting
MATERIALS FOR CONNECTION:
Tapping Tee Sleeves, 20" long
Tapping Valve and Box
321 LF, 8" Ductile Iron Pipe, Class 53
TEMPORARY FOR TESTING:
1-8" Cap Tapped for 2.5" IPT
1-2.5" Cleanout
1-Conc. block (Temp. for testing)

Water Line "TA" Sta. 3+15.08
=A ℄ Sta. 778+38.43, o/s 8.00' Rt.
1-8" 1/4 Bend (H), 1-Conc. Block

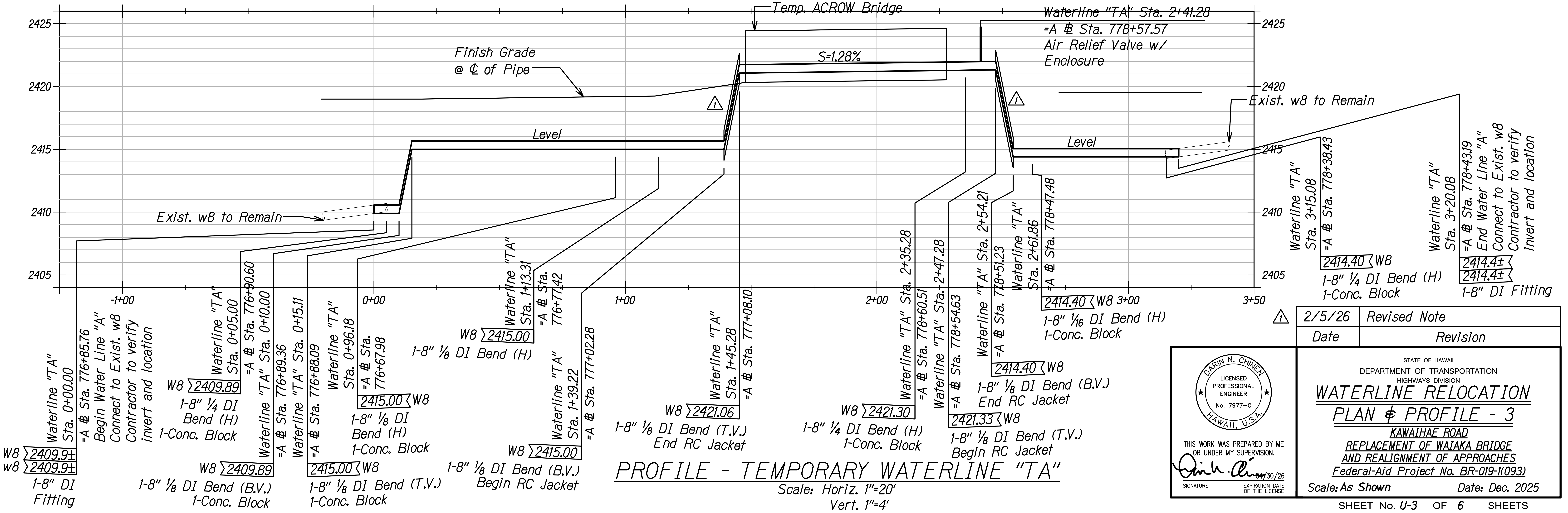
UTILITY RELOCATION PLAN - WATERLINE "TA"

Scale 1"=20'

APPROVED:

MANAGER & CHIEF ENIGINEER, DWS
(For Work Affecting DWS Facilities in
County/State Right-of-Way
and DWS Easement only)

DATE



Waterline "TA" Sta. 2+41.28
=A ℄ Sta. 778+57.57
Air Relief Valve w/
Enclosure

Waterline "TA"
Sta. 0+00.00
=A ℄ Sta. 776+85.76
Begin Water Line "A"
Connect to Exist. w8
Contractor to verify
invert and location
W8 2409.9±
w8 2409.9±
1-8" DI
Fitting

Waterline "TA"
Sta. 0+05.00
=A ℄ Sta. 776+90.60
W8 2409.89
1-8" 1/4 DI
Bend (H)
1-Conc. Block

Waterline "TA" Sta. 0+10.00
=A ℄ Sta. 776+89.36
W8 2409.89
1-8" 1/8 DI Bend (B.V.)
1-Conc. Block

Waterline "TA" Sta. 0+15.11
=A ℄ Sta. 776+88.09
2415.00 W8
1-8" 1/8 DI Bend (T.V.)
1-Conc. Block

Waterline "TA"
Sta. 0+96.18
=A ℄ Sta.
776+67.98
2415.00 W8
1-8" 1/8 DI
Bend (H)
1-Conc. Block

Waterline "TA"
Sta. 1+13.31
=A ℄ Sta.
776+77.42
W8 2415.00
1-8" 1/8 DI Bend (H)

Waterline "TA"
Sta. 1+39.22
=A ℄ Sta. 777+02.28
W8 2415.00
1-8" 1/8 DI Bend (B.V.)
Begin RC Jacket

Waterline "TA"
Sta. 1+45.28
=A ℄ Sta. 777+08.10
W8 2421.06
1-8" 1/8 DI Bend (T.V.)
End RC Jacket

Waterline "TA" Sta. 2+35.28
=A ℄ Sta. 778+60.51
W8 2421.30
1-8" 1/4 DI Bend (H)
1-Conc. Block

Waterline "TA" Sta. 2+47.28
=A ℄ Sta. 778+54.63
2421.33 W8
1-8" 1/8 DI Bend (T.V.)
Begin RC Jacket

Waterline "TA" Sta. 2+54.21
=A ℄ Sta. 778+51.23
2414.40 W8
1-8" 1/8 DI Bend (B.V.)
End RC Jacket

Waterline "TA"
Sta. 2+61.86
=A ℄ Sta. 778+47.48
2414.40 W8
1-8" 1/16 DI Bend (H)
1-Conc. Block

Waterline "TA"
Sta. 3+15.08
=A ℄ Sta. 778+38.43
2414.40 W8
1-8" 1/4 DI Bend (H)
1-Conc. Block

Waterline "TA"
Sta. 3+20.08
=A ℄ Sta. 778+43.19
End Water Line "A"
Connect to Exist. w8
Contractor to verify
invert and location
2414.4±
2414.4±
1-8" DI Fitting

PROFILE - TEMPORARY WATERLINE "TA"

Scale: Horiz. 1"=20'
Vert. 1"=4'

	Date	Revision
1	2/5/26	Revised Note

DARIN N. CHINEN
LICENSED PROFESSIONAL ENGINEER
No. 7977-C
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME
OR UNDER MY SUPERVISION.
04/30/26
SIGNATURE
EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

WATERLINE RELOCATION
PLAN & PROFILE - 3

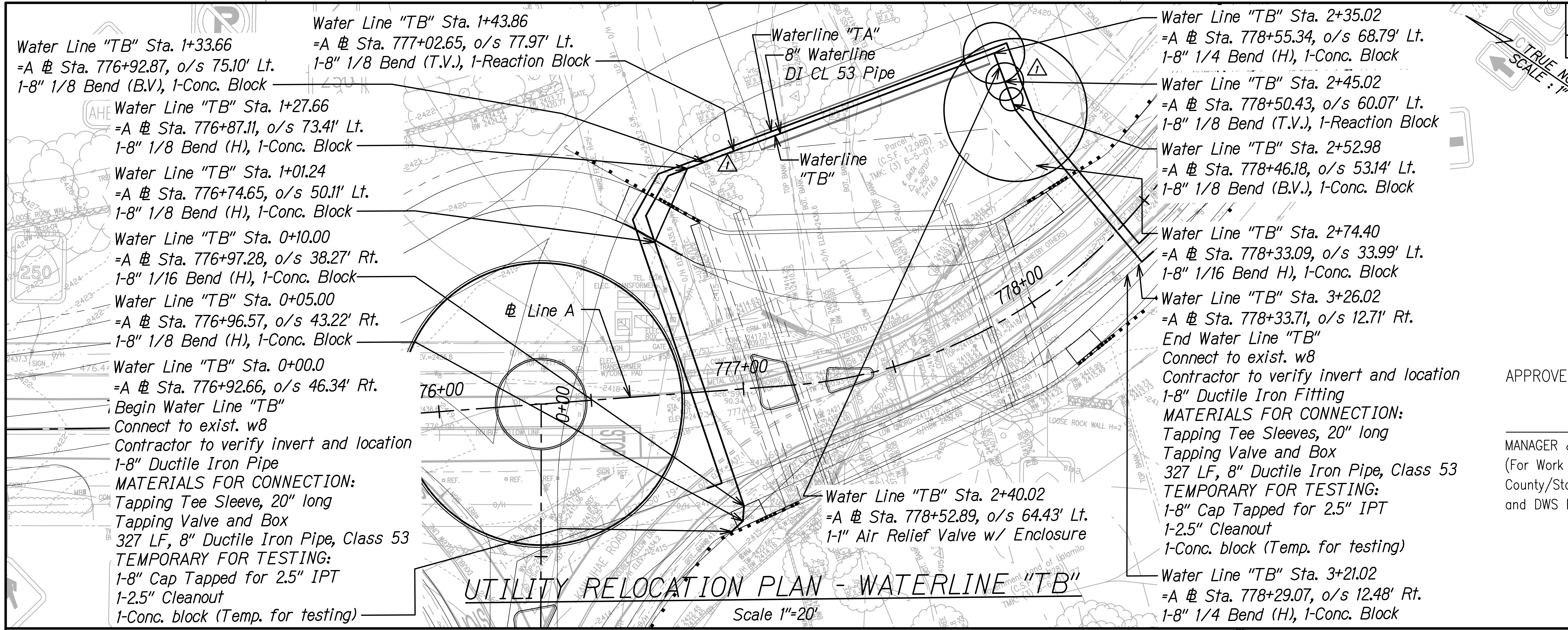
KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
Federal-Aid Project No. BR-019-1(093)

Scale: As Shown
Date: Dec. 2025

SHEET No. U-3 OF 6 SHEETS

ORIGINAL PLAN
NOTE BOOK
No.
SURVEY PLOTTED BY
DRAWN BY
TRACED BY
DESIGNED BY
QUANTITIES BY
CHECKED BY
DATE

FED. ROAD DIST. NO.	STATE	FEDERAL AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-019-1(093)	2026	ADD. 60	198



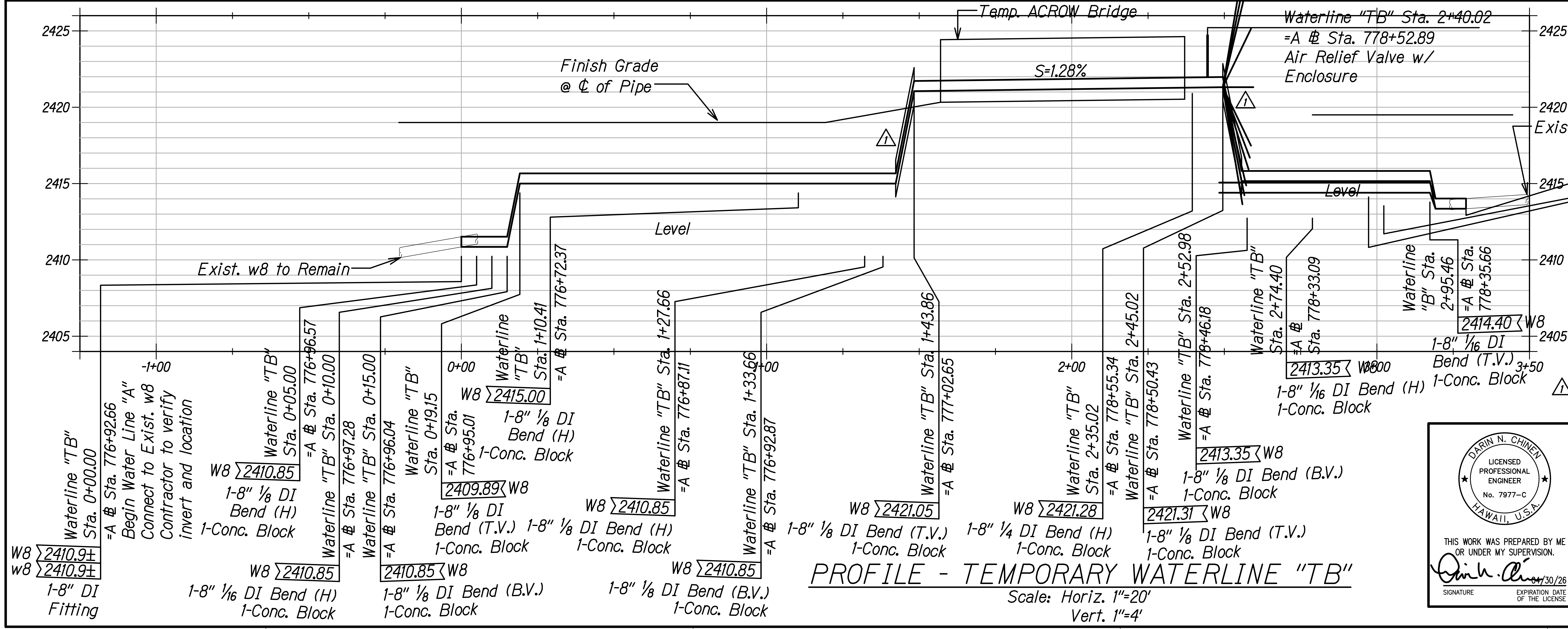
UTILITY RELOCATION PLAN - WATERLINE "TB"

Scale 1"=20'

APPROVED:

MANAGER & CHIEF ENIGINEER, DWS
(For Work Affecting DWS Facilities in County/State Right-of-Way and DWS Easement only)

DATE



PROFILE - TEMPORARY WATERLINE "TB"

Scale: Horiz. 1"=20'
Vert. 1"=4'

Date	Revision
2/5/26	Revised Note

DARIN N. CHINEN
LICENSED PROFESSIONAL ENGINEER
No. 7977-C
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.

Darin N. Chinen 04/30/26
SIGNATURE
EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

WATERLINE RELOCATION
PLAN & PROFILE - 4

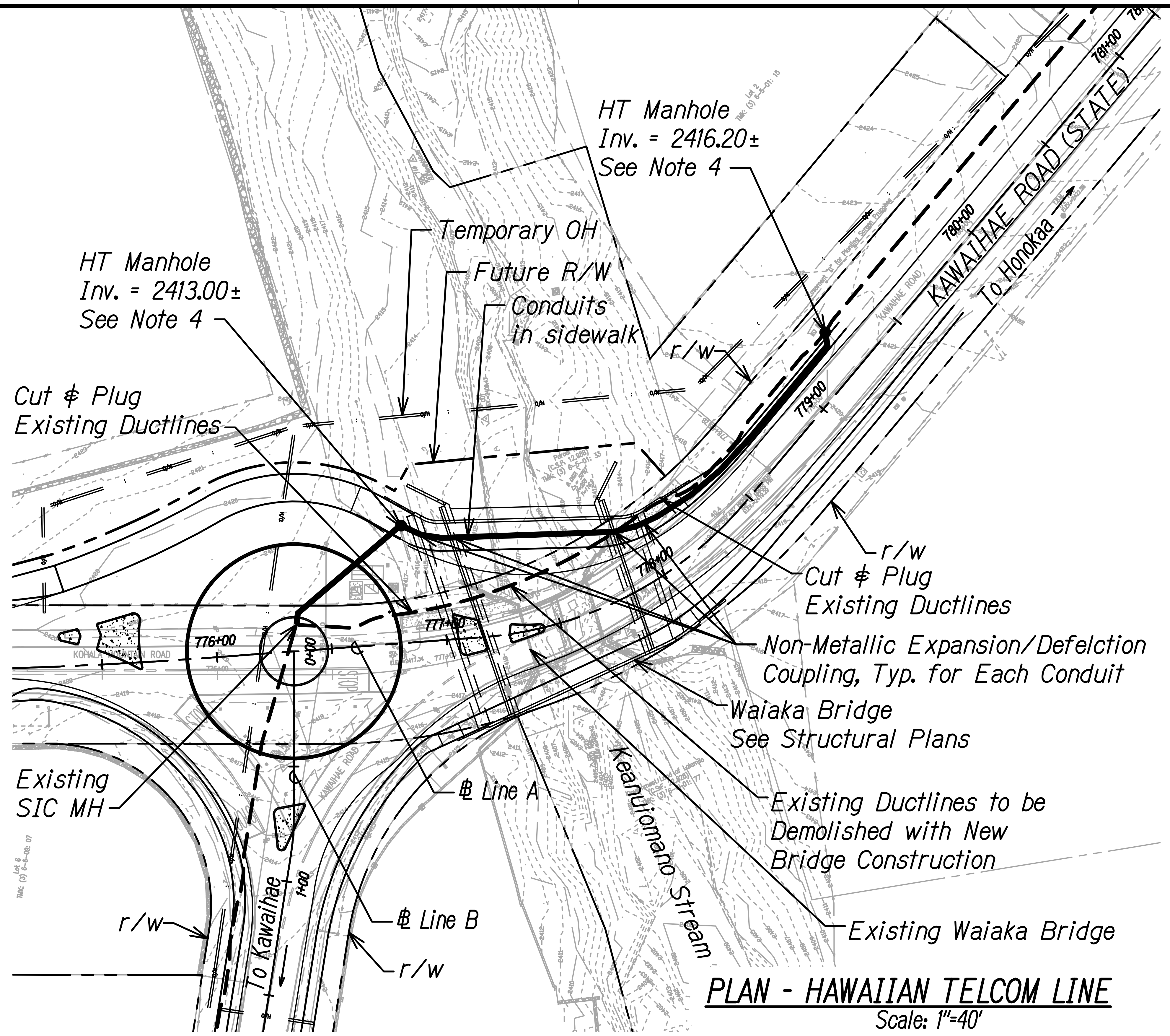
KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
Federal-Aid Project No. BR-019-1(093)

Scale: As Shown
Date: Dec. 2025

SHEET No. U-4 OF 6 SHEETS

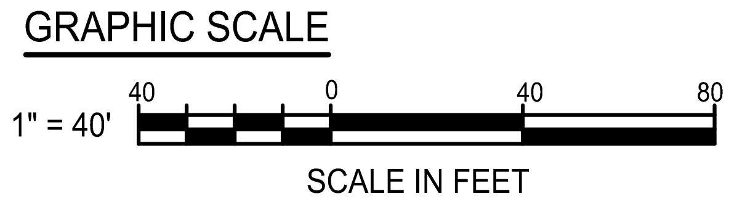
ORIGINAL PLAN
NOTE BOOK
No.
SURVEY PLOTTED BY
DRAWN BY
TRACED BY
DESIGNED BY
QUANTITIES BY
CHECKED BY
DATE

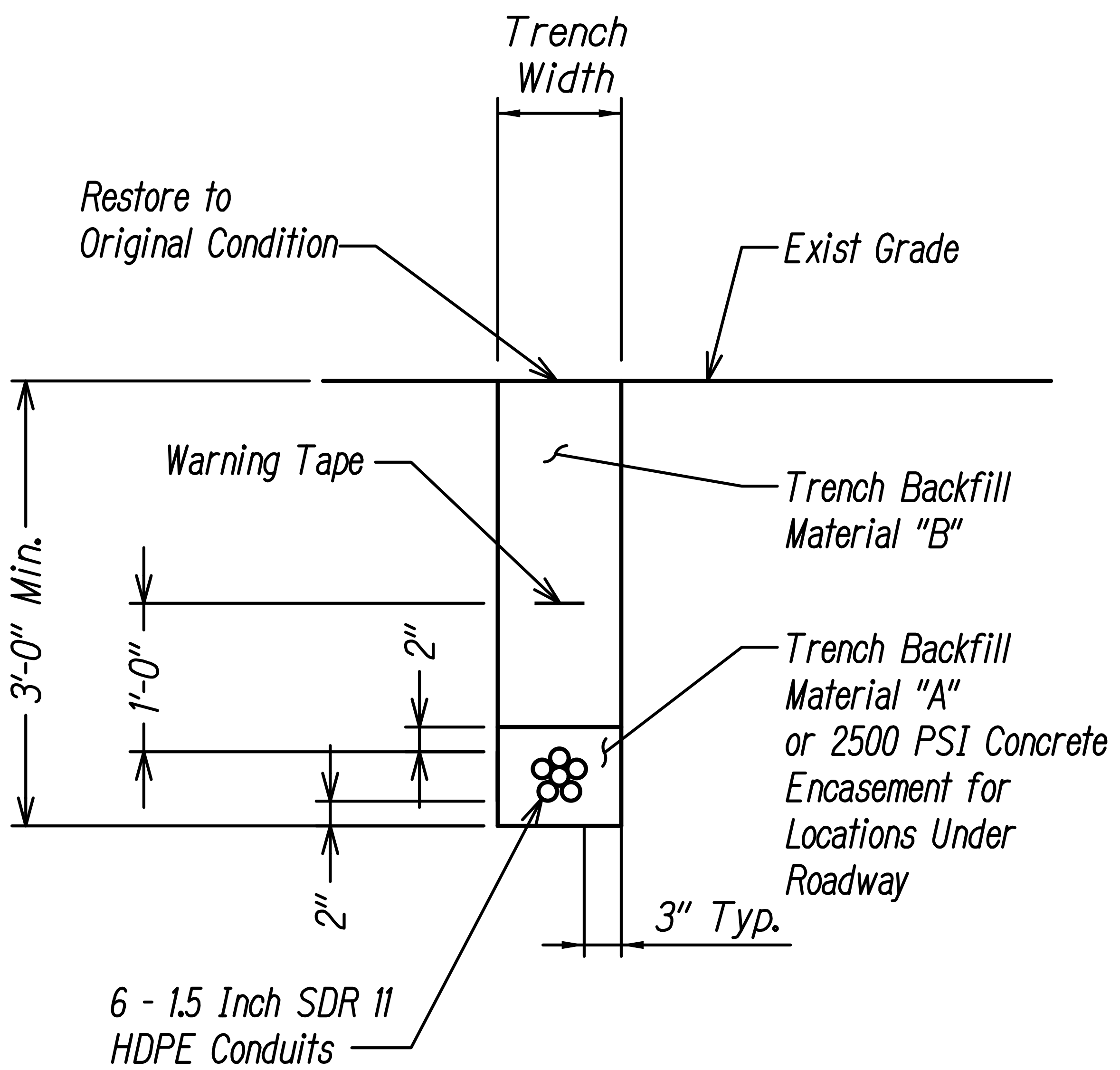
FED. ROAD DIST. NO.	STATE	FEDERAL AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-019-1(093)	2026	ADD.62S-1	198



PLAN - HAWAIIAN TELCOM LINE

Scale: 1"=40'





TRENCH RESTORATION DETAIL

Scale: N.T.S.

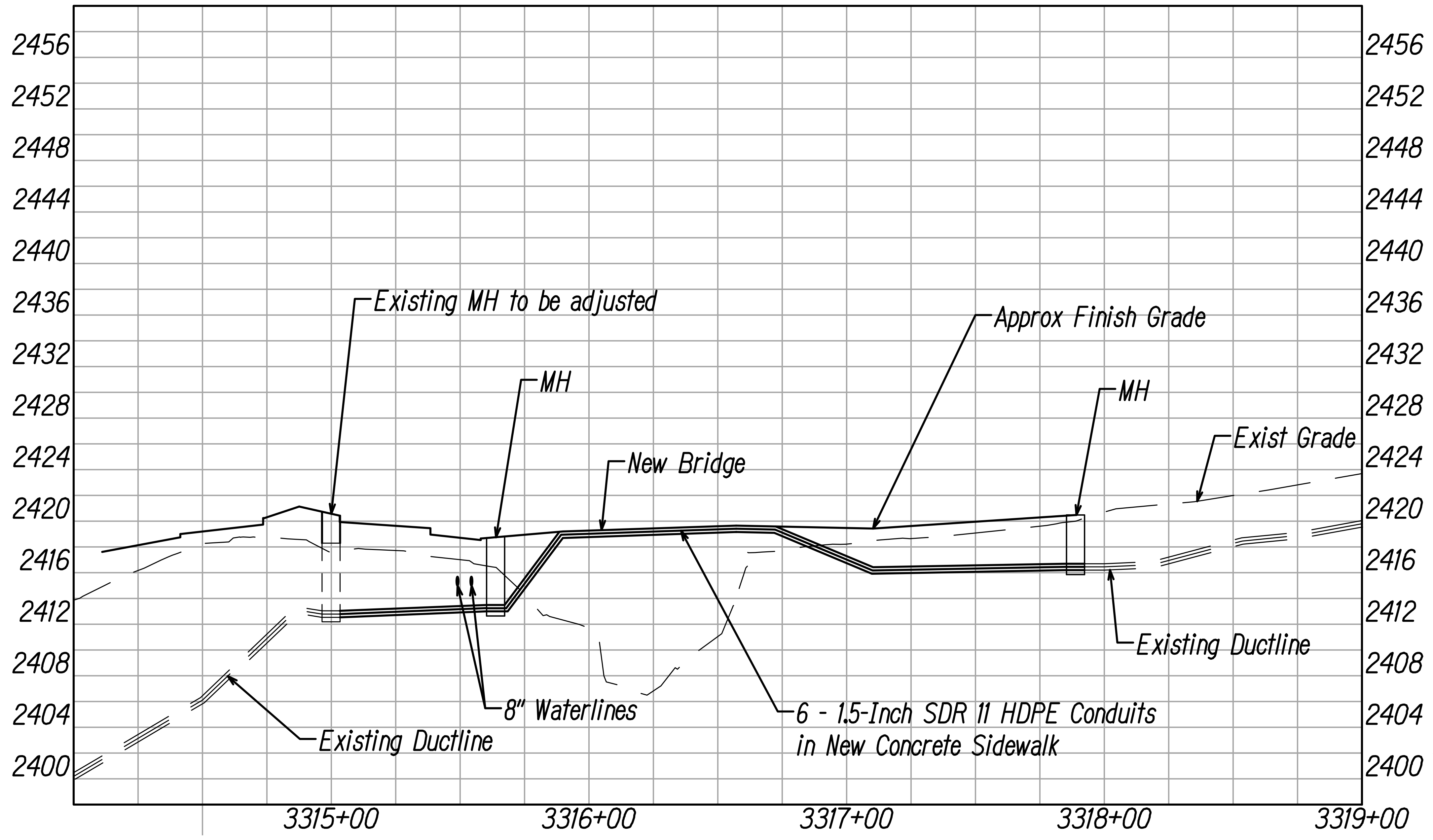
NOTES:

Trench Backfill Material "A"
1. Sand Equivalent (S.E.) ≥ 20
2. 8" Maximum Lifts
3. 95% Compaction

Trench Backfill Material "B"
1. S.E. must not be less than the area being filled and in no case shall the S.E. be < 2 regardless of where it is used.
2. 8" Maximum Lifts
3. 95% Compaction

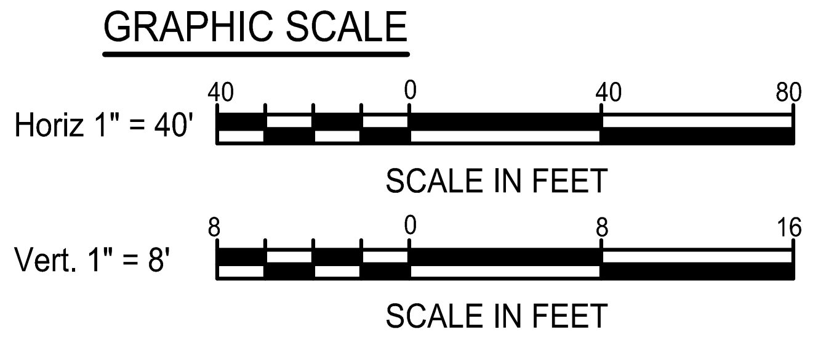
NOTES:

1. Existing fiber optic cables at existing stream crossing will be temporarily relocated overhead by HT prior to start of construction.
2. Abandoned ductlines to be cut/plug and demolished as need for new bridge construction.
3. HT will relocate fiber optic cables from overhead to underground upon completion of new ductline system.
4. Provide HT standard 4'x6'-6"x6'-6" manhole (Drawing #34029).



PROFILE - HAWAIIAN TELCOM LINE

Horiz. Scale: 1"=40'
Vert. Scale: 1"=8'



	Date	Revision
1	2/5/26	New Sheet

DARIN N. CHINEN
LICENSED PROFESSIONAL ENGINEER
No. 7977-C
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME
OR UNDER MY SUPERVISION.

04/30/26

SIGNATURE — EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

TELEPHONE PLAN & PROFILE

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
Federal-Aid Project No. BR-019-1(093)

Scale: As Noted — Date: Dec. 2025

SHEET No. U-6A OF 6 SHEETS

ADD. 62 S-1

ORIGINAL PLAN
NOTE BOOK
No.
SURVEY PLOTTED BY
DRAWN BY
TRACED BY
DESIGNED BY
QUANTITIES BY
CHECKED BY
DATE

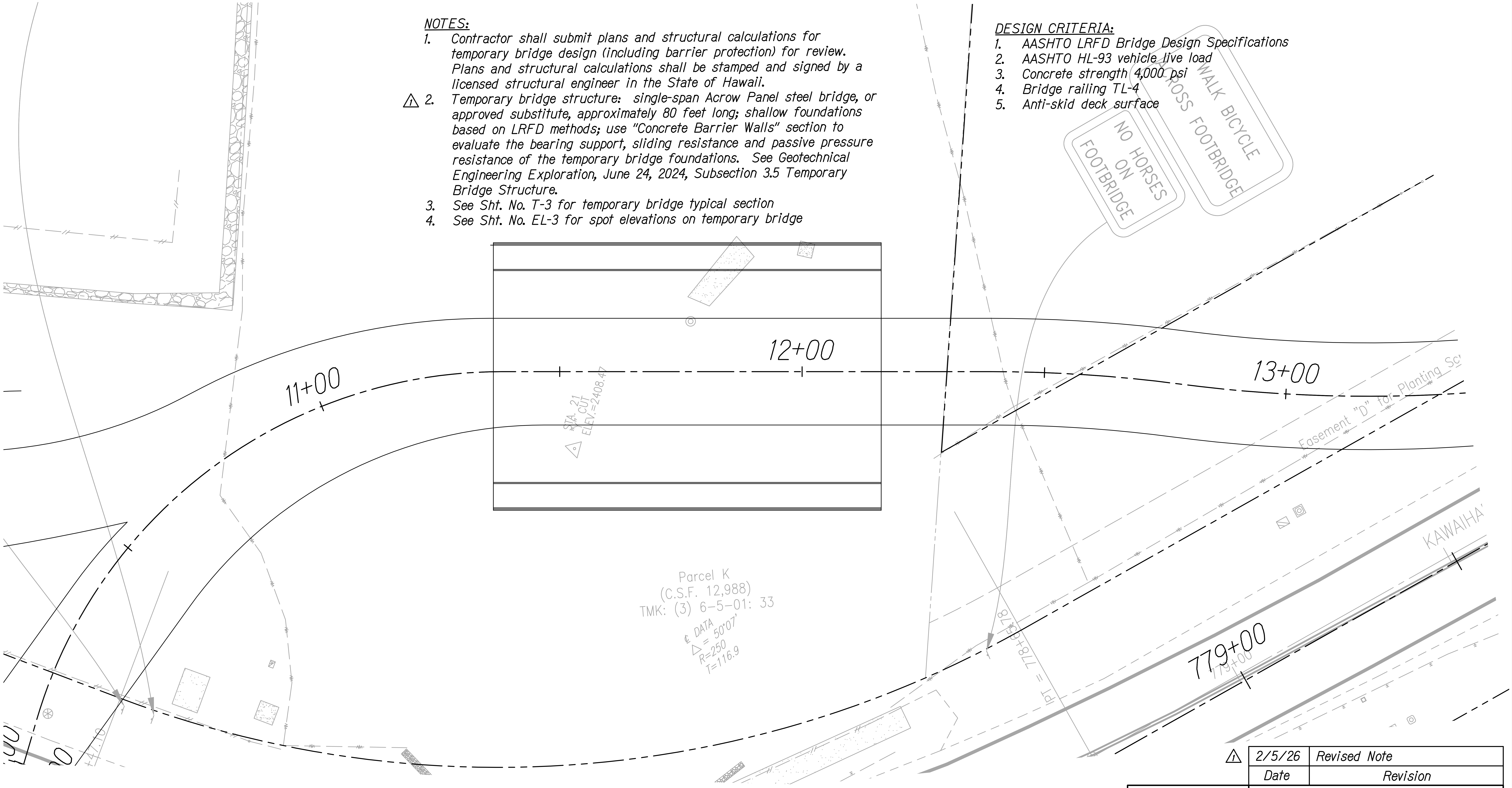
FED. ROAD DIST. NO.	STATE	FEDERAL AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-019-1(093)	2026	ADD. 63	198

NOTES:

1. *Contractor shall submit plans and structural calculations for temporary bridge design (including barrier protection) for review. Plans and structural calculations shall be stamped and signed by a licensed structural engineer in the State of Hawaii.*
2. △1 *Temporary bridge structure: single-span Acrow Panel steel bridge, or approved substitute, approximately 80 feet long; shallow foundations based on LRFD methods; use "Concrete Barrier Walls" section to evaluate the bearing support, sliding resistance and passive pressure resistance of the temporary bridge foundations. See Geotechnical Engineering Exploration, June 24, 2024, Subsection 3.5 Temporary Bridge Structure.*
3. *See Sht. No. T-3 for temporary bridge typical section*
4. *See Sht. No. EL-3 for spot elevations on temporary bridge*

DESIGN CRITERIA:

1. *AASHTO LRFD Bridge Design Specifications*
2. *AASHTO HL-93 vehicle live load*
3. *Concrete strength 4,000 psi*
4. *Bridge railing TL-4*
5. *Anti-skid deck surface*



GRAPHIC SCALE
1" = 10' 10 0 10 20
SCALE IN FEET

△1	Date	Revision
	2/5/26	Revised Note

DARIN N. CHINEN
LICENSED PROFESSIONAL ENGINEER
No. 7977-C
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.
04/30/26
SIGNATURE — EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

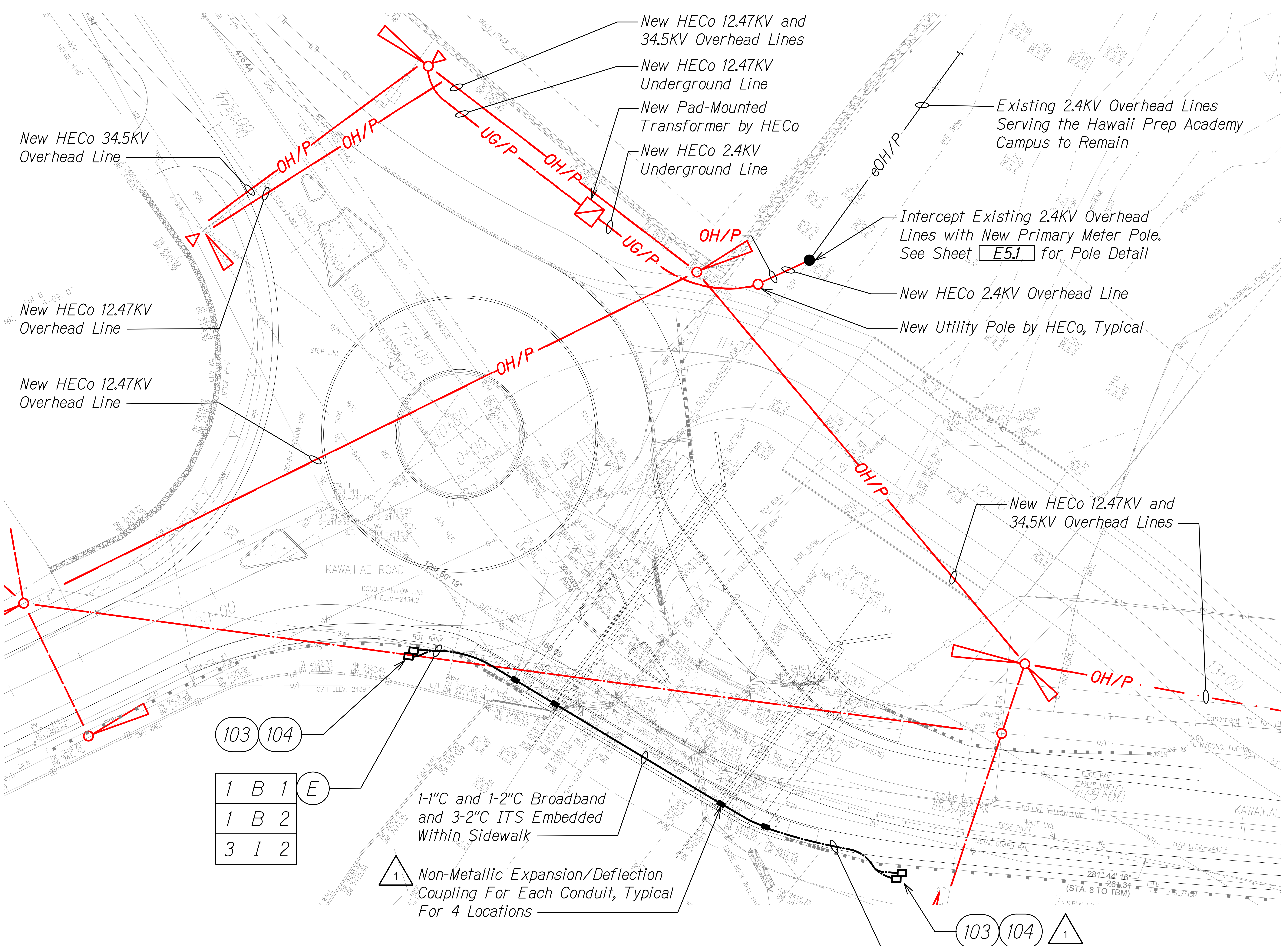
TEMPORARY BRIDGE PLAN

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
Federal-Aid Project No. BR-019-1(093)
Scale: 1" = 10'   Date: Dec. 2025

SHEET No. BR-1 OF 1 SHEETS

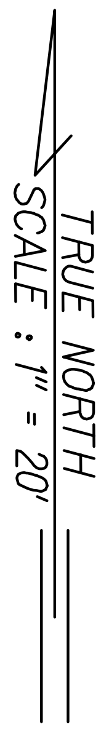
ORIGINAL PLAN
SURVEY PLOTTED BY ____ DATE ____
DRAWN BY ____ " ____
TRACED BY ____ " ____
NOTE BOOK
DESIGNED BY ____ " ____
QUANTITIES BY ____ " ____
No. ____
CHECKED BY ____ " ____

FED. ROAD DIST. NO.	STATE	FEDERAL AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-019-1(093)	2026	71	198



ENLARGED SITE ELECTRICAL PLAN

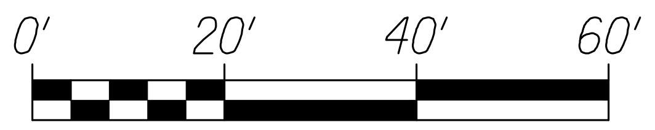
SCALE: 1"= 20'-0"



Notes:

1. Light Lines Denote Existing Condition
   Bold Lines Denote New Work
   Red Lines Denote New Work by HECo

GRAPHIC SCALE:



1" = 20'-0"

	Date	Revision
1	2/5/26	Added Def/Exp Couplings; Revised Notes

RUSSELL K. MORI
LICENSED PROFESSIONAL ENGINEER
No. 9013-E
HAWAII, U.S.A.
2/4/25
MK ENGINEERS, LTD.
LICENSE EXPIRATION DATE: 4/30/26
THIS WORK WAS PREPARED BY ME
OR UNDER MY SUPERVISION.
Russell K. Mori

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

ENLARGED SITE ELECTRICAL PLAN

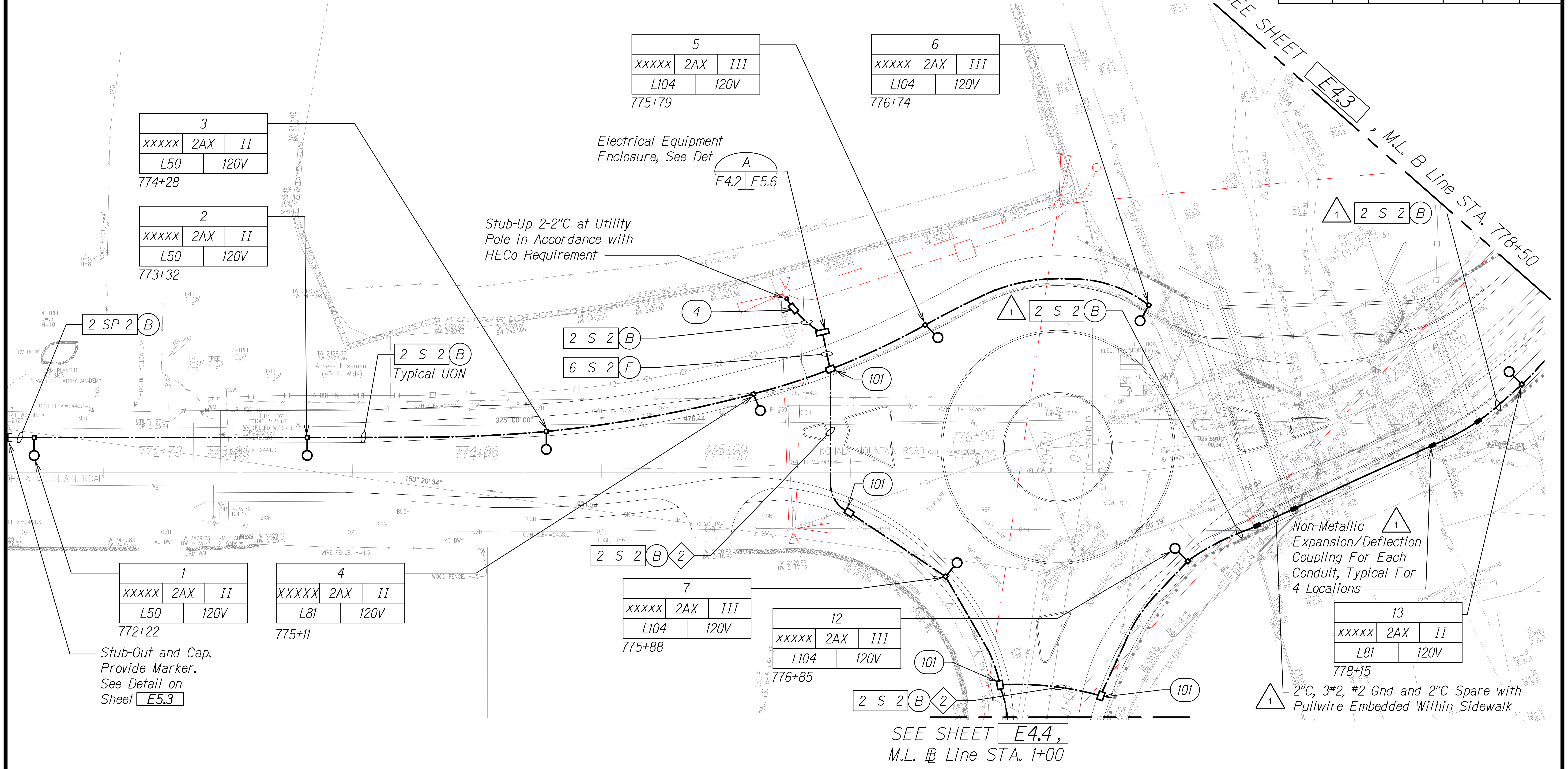
KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
Federal-Aid Project No. BR-019-1(093)

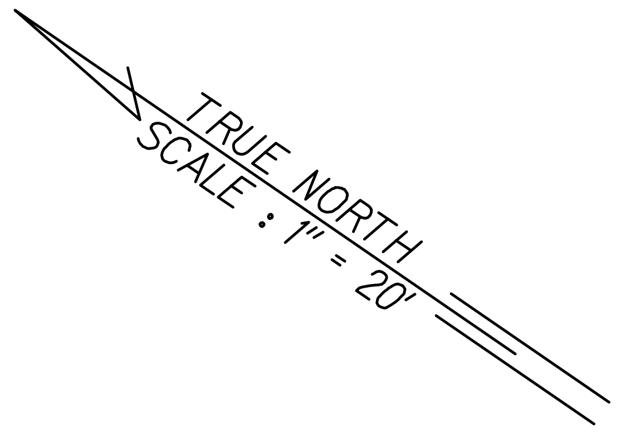
Scale: As Noted
Date: Dec. 2025

SHEET No. E2.2 OF 24 SHEETS

ORIGINAL PLAN
NOTE BOOK
No. ____
SURVEY PLOTTED BY ____ DATE ____
DRAWN BY ____ " ____
TRACED BY ____ " ____
DESIGNED BY ____ " ____
QUANTITIES BY ____ " ____
CHECKED BY ____ " ____

FED. ROAD DIST. NO.	STATE	FEDERAL AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-019-1(093)	2026	74	198





ENLARGED SITE LIGHTING PLAN - A

SCALE: 1"= 20'-0"

Notes:

1. All Electrical Work Shown on This Plan is New.

2. Refer to Sheet E5.4 for Restoration Detail of New Duct Line within a Paved Area.

GRAPHIC SCALE:

0' 20' 40' 60'

1" = 20'-0"

	Date	Revision
1	2/5/26	Added Def/Exp Couplings; Revised Notes

RUSSELL K. MORI
LICENSED PROFESSIONAL ENGINEER
No. 9013-E
HAWAII, U.S.A.
2/4/26

MK ENGINEERS, LTD.
LICENSE EXPIRATION DATE: 4/30/26
THIS WORK WAS PREPARED BY ME
OR UNDER MY SUPERVISION.

Russell Mori

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

ENLARGED SITE LIGHTING PLAN - A

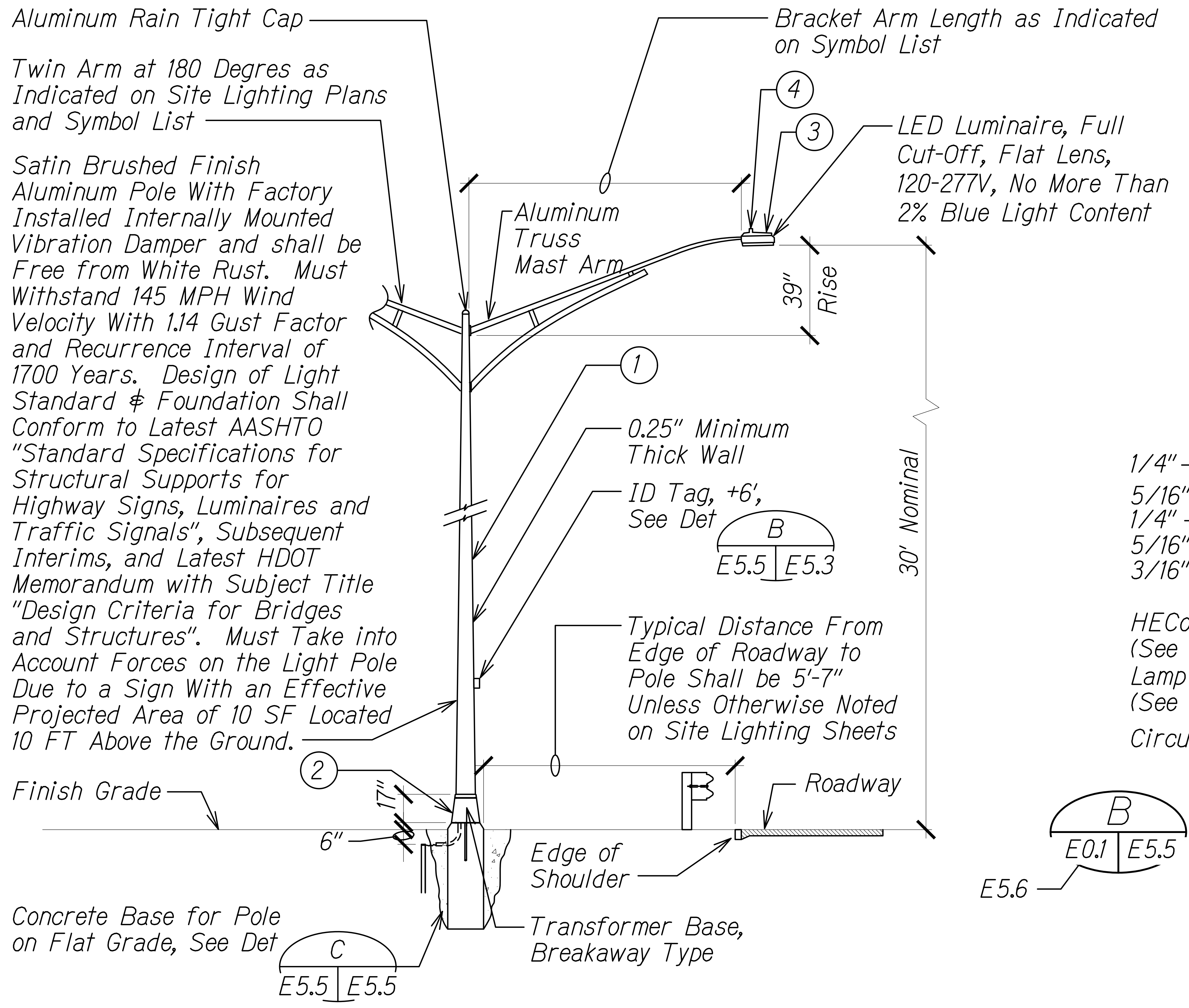
KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
Federal-Aid Project No. BR-019-1(093)

Scale: As Noted Date: Dec. 2025

SHEET No. E4.2 OF 24 SHEETS

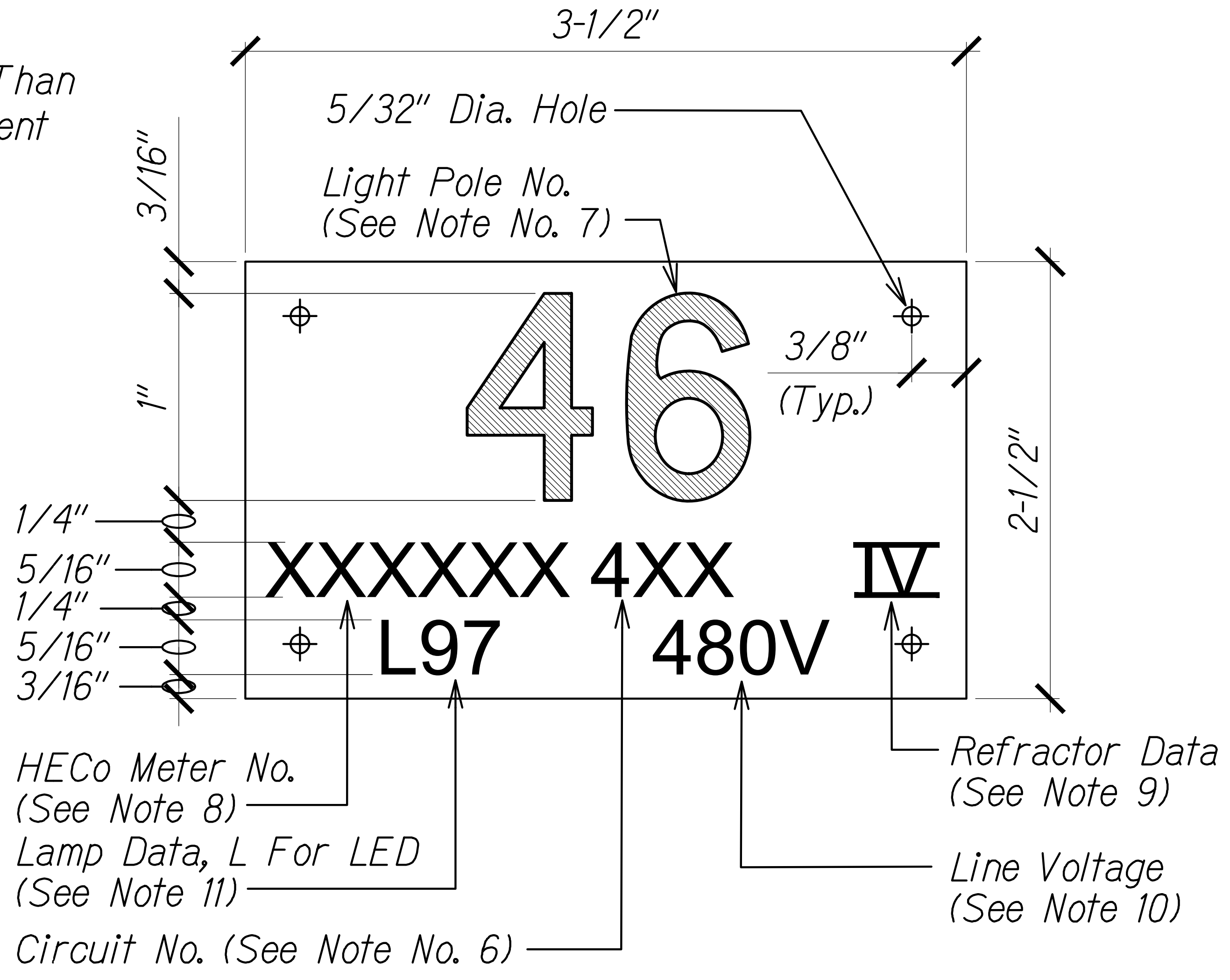
ORIGINAL PLAN	SURVEY PLOTTED BY	DATE
	DRAWN BY	"
NOTE BOOK	TRACED BY	"
	DESIGNED BY	"
	QUANTITIES BY	"
No.	CHECKED BY	"

FED. ROAD DIST. NO.	STATE	FEDERAL AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-019-1(093)	2026	82	198



A E0.1 E5.5 ROADWAY LIGHT STANDARD DETAIL

Not To Scale



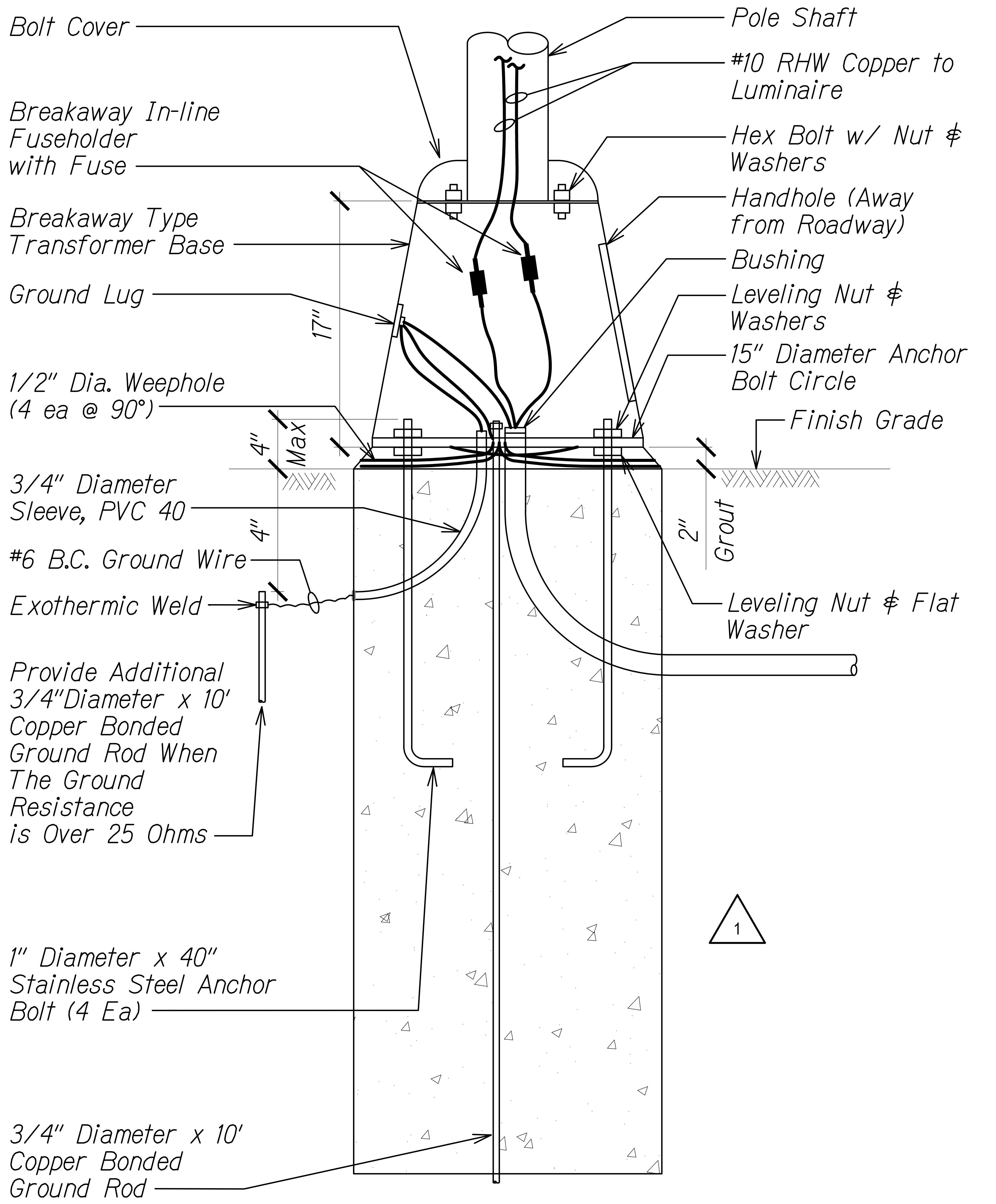
B E0.1 E5.5 LIGHT POLE TAG DETAIL

E5.6

Not To Scale

Notes:

1. Use 3 Ply Laminated Flexible Plastic Black-White-Black Thickness Black Cap Sheet-0.010", White Base Sheet-0.052", Black Base Sheet-0.010".
2. Light Pole Number Size Shall Be 1" High and Engraved 1/8" Wide, White in Color (Number as Required).
3. Nomenclature Size Shall be 5/16" High and Engraved 1/32" Wide, White in Color (HECo Meter Number Panel Board and Circuit Number, Line Voltage, Lamp Data and Refractor Data as Required).
4. Attach to Aluminum and Steel Post with No. 8 Stainless Steel, 1/2" Long Drive Screws in 1/8" Drill Hole. Attach to Wood Poles with 4D Aluminum Nail.
5. Numbers are Inscribed by Cutting Through "Black Cap Sheet" to Expose "White Letters."
6. Nomenclature Required for Systems with Two or More Circuits (Letter Indicates Panel Board, Number Indicates Circuit).
7. Light Numbers Shall be Obtained From the Site Plans. Use an Alphabet Suffix to Designate Lights Mounted on the Same Pole (e.g. 123A & 123B).
8. Where not Indicated on Site Plans, Obtain HECo Meter No. at Electrical Equipment Enclosure, See Site Plans to Determine the Electrical Enclosure.
9. Refractor Data Shall Be Obtained From the Site Plans.
10. Line Voltage Data Shall Be Obtained From the Site Plans.
11. Lamp Data Shall be Obtained From the Site Plans.



C E5.5 E5.5 TYPICAL TRANSFORMER BASE DETAIL

Not To Scale

MATERIAL LIST

ITEM	DESCRIPTION	MANUFACTURER
1	Light Pole, Aluminum	
2	Transformer Base (Aluminum) (Breakaway Type)	
3	Luminaire, LED, Wattage and Distribution Type as Indicated on Symbol List	50W, Type II, Cree Lighting GWYM-A-8L-19K5-2M-UL-Gray-20KV/10KA 81W, Type II, Cree Lighting GWYM-A-13L-19K5-2M-UL-Gray-20KV/10KA 104W, Type III, Cree Lighting GWYM-A-17L-19K5-3M-UL-Gray-20KV/10KA
4	Photocell	

	Date	Revision
1	2/5/26	Deleted Note

No. 9013-E
2/4/26
MK ENGINEERS, LTD.
LICENSE EXPIRATION DATE: 4/30/26
THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.
Russell K. Mori

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

ROADWAY LIGHT STANDARD DETAIL

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
Federal-Aid Project No. BR-019-1(093)
Scale: As Noted
Date: Dec. 2025

SHEET No. E5.5 OF 24 SHEETS

ADD. 82

ORIGINAL PLAN
NOTE BOOK
No.
SURVEY
PLOTTED BY
DRAWN BY
TRACED BY
DESIGNED BY
QUANTITIES BY
CHECKED BY
DATE

KAWAIHAE ROAD, REPLACEMENT OF WAIAKA BRIDGE AND REALIGNMENT OF APPROACHES ISLAND OF HAWAII

FEDERAL-AID PROJECT NO. BR-019-1(093)

PRE-BID MEETING MINUTES
January 26, 2026

The following notes are from the Hawaii Department of Transportation (HDOT) pre-bid meeting with prospective bidders for the Kawaihae Road, Replacement of Waiaka Bridge and Realignment of Approaches, Island of Hawaii project.

The meeting was conducted virtually via Microsoft Teams at 10:30 am.

All attendees were notified of the following:

- Scope of work consists of reconstruction of the existing T-intersection at Kawaihae Road and Kohala Mountain Road into a roundabout. The project includes replacing Waiaka Bridge, reconstruction of AC pavement; removing existing pavement, guardrails, fences and trees; constructing curbs, Portland cement concrete truck apron; installing guardrails, signs and pavement markings; adjusting and relocating utilities; cold planing; erosion control; and traffic control.

- There are no Disadvantage Business Enterprise requirements for this contract.

- Per Spec 672.03, night work and weekend work shall only be allowed for the four concrete pours noted in the Application for Community Noise Variance and the Variance for Community Noise Control for the new bridge deck, abutment end beams and various closure pours. The expected pours would occur every four to six weeks with each pour consisting of up to two consecutive nights of work. Concrete pours shall not be done during the seabird fledging season (September 15 to December 15)

- Noise Variance requirements for night work; to include notifications to the community (see noise variance request) prior to each proposed night work concrete pour. The contractor shall provide noise sampling during variance days and hours as noted in the Variance for Community Noise Control.

- Archeological monitoring is included in this contract.

- Per Spec 108.01, the Start Work date may be established up to 180 days from the project notice-to-proceed. This extended period is required for Hawaiian Electric, Hawaiian Telcom, and Spectrum to complete pole and overhead line relocation work prior to physical start work

- There are Utility Agreements and MOU with Hawaiian Electric, Department of Water Supply, Hawaiian Tel, and Spectrum.

- Spec 695, Public Education Campaign requires the contractor to have a public website for project information and contact information.

- Spec 621, Invasive Species Management is part of this contract.

- Spec 961, Unexploded Ordnance (UXO) Training will be provided by the U.S. Corps of Engineers at no cost, before any excavation is conducted, so construction personnel are aware of expected procedures if a UXO is encountered.

- The bid opening date is set for February 13, 2026 at 2:00pm.

- RFI questions are due via HIePRO by January 30, 2026 at 2:00pm.

Attendance List:
HDOT
WSP
KSF
Alpha Inc.
Ariz Co., LLC
Goodfellow Bros.
Isemoto Contracting Co., Ltd.
Jas. W. Glover, Ltd.
Nan Inc.
Orion Group Holdings, Inc.
WW Clyde

The meeting ended at 11:08 am.

All items discussed at this meeting are for clarification only. The bid documents shall govern over anything said at the meeting and discrepancies shall be clarified in Addendum No. 1.

Questions for solicitation: B26001542 BR-019-1(093), Replace Waiaka Stream Bridge

01/30/2026

1. **Sheet S6.1 indicates 3 - 6" PVC voids. It is typical practice to utilize Sonotube in lieu of PVC for creating these voids in Voided Slabs. Please verify if this is acceptable.**

Sonotube is acceptable for use in lieu of PVC, provided the following requirements are met:

- The voids are intact after pour and the same size and shape shown in the contract documents. I.e. sonotube is not compromised by the weight of fresh concrete or any leaks at the joints or ends.
- Contractor shall weigh beams and compare actual weight to the theoretical weight of the hollow core beams.
- Drains are in place as shown in the contract drawings
- Calculated cambers and deflections are not affected.

If any of these requirements are not met, beams will need to be replaced.

2. **Sheet 63- Temporary Bridge Plan - Please guide bidders to and/or provide Geotechnical Engineering Exploration, June 24, 2024, subsection 3.5 Temporary Bridge Structure - as referenced on Note #2. Thank you.**

Geotechnical Engineering Exploration Report, dated June 24, 2024, will be provided with addendum documents.

3. **Sheet 82 detail C calls out "See structural drawings for concrete base detail". Please provide reinforcing detail and dimensions of the roadway light concrete base.**

Contractor shall provide foundation design per callout noted in Detail A of Sheet 82. Addendum Sheet 82 is being issued to clarify these requirements. Design shall be stamped by a structural engineer licensed in the state of Hawaii.

4. **Was a lead-based paint survey for the project conducted? If so, please provide.**

No lead-based paint survey was conducted.

5. **Requesting to postpone bid date for another two weeks to allow for more time to coordinate between subs & vendors. Also, there are multiple projects bidding that day.**

Bid date will not be postponed.

6. **Requesting to have Bid Item: 202.2000 Hawaiian Telcom Relocation Work to be a Force Account or Allowance item.**

See addendum plans for added Hawaiian Telcom Relocation work. Bid item will remain Lump Sum.

7. **Requesting to have Bid Item: 202.3000 HELCO Relocation Work to be a Force Account or Allowance item.**

Bid Item 202.3000 is deleted. Addendum Proposal Schedule is being issued to clarify.

8. **What is the thickness of the AC Sidewalk Transition work? This referencing plan sheet 24 and 26.**

Thickness varies 6 inches to 2 inches.

9. **Plan sheet 29 shows that the 12" Trench Former TFX drain is under 6" thick concrete sidewalk. However, plan sheet 24 and 26 shows that it is under A.C. sidewalk. Please advise.**

Trench Former TFX drain is under A.C. sidewalk.

10. **Requesting to have Bid Item: 621.1000 Inventory of Invasive Species before Construction to be a Force Account or Allowance item.**

Bid item will remain Lump Sum.

11. **Requesting to have Bid Item: 621.4000 Monitoring of Invasive Species during and after Construction to be a Force Account or Allowance item.**

Bid item will remain Lump Sum.

12. **Requesting to have Bid Item: 621.5000 Post-Construction Inventory Prior to Returning the Site to the State to be a Force Account or Allowance item.**
Bid item will remain Lump Sum.

13. **Which bid item does the truncated dome detectable warning surface mats go under? Will there be a separate bid item for this work?**

Detectable warnings are included in Bid Item 650.1000.

14. **Special Provision Section 102.14 and Temporary Bridge Plan (Sheet 63): The Temporary Bridge Plan requires the Contractor to provide a delegated design for the temporary bridge, with design criteria identified on Sheet 63 and calculations prepared and stamped by a Hawaii-licensed professional engineer. Question: Please confirm whether the temporary bridge system is considered a contractor-designed temporary works and whether an alternate engineered temporary bridge system may be proposed and submitted for review, provided it meets the required 80' span, roadway width, loading, and geometric constraints, without being processed as a pre-bid material substitution under Special Provision Section 102.14.**

See revised addendum plan.

15. **Would you consider extending the bid due date from February 13 to February 27 to allow our team adequate time to prepare a complete and responsive proposal?**

Bid date will not be postponed.

16. **In the Notice to Bidders, page NTB-3 outlines information regarding Disadvantaged Business Enterprise (DBE) requirements. However, it is our understanding that DBE requirements are no longer applicable to State Department of Transportation projects. Please confirm whether DBE participation requirements apply to this project.**

DBE participation requirements not applicable for this project.

17. **Bid Item 202.2000 Hawaiian Telecomm Relocation Work is currently a Lump Sum item in the proposal schedule. This places the responsibility for all utility fees and charges associated with this scope of work on the bidder, however the bidder does not have a contractual relationship with the Utility. The bidder has no way to request a proposal from the Utility for these fees, nor to require them to honor any proposals**

after contract award. Please advise an alternative for pricing this scope of work that more fairly distributes risk on this item (for example: Allowance or Force Account.)

See addendum plans for added Hawaiian Telcom Relocation work. Bid item will remain Lump Sum.

18. **Bid Item 202.3000 HELCO Relocation Work is currently a Lump Sum item in the proposal schedule. This places the responsibility for all utility fees and charges associated with this scope of work on the bidder, however the bidder does not have a contractual relationship with the Utility. The bidder has no way to request a proposal from the Utility for these fees, nor to require them to honor any proposals after contract award. Please advise an alternative for pricing this scope of work that more fairly distributes risk on this item (for example: Allowance or Force Account.)**
Addendum Proposal Schedule is being issued to clarify. 202.3000 is deleted.

19. **Can the bid date be extended please?**

Bid date will not be postponed.

20. **The specification section for bid Item 690.1000 Removal and Disposal of Lead-Based Paint indicates that a study of the jobsite needs to be conducted and a Hazardous Wast Management Plan be submitted within 45 calander days after award of contract. The pay item is listed as forca account. How is this study to be completed with a managament plan in time as well as to be paid. The basis of payment is based on lead based paint removed and disposed. If there is an overrun of the item amount, will the contractor be compensated? If no lead based paint is identified, will the contractor be compensated for testing of materials? Suggest the allowance be increased, as $10,000.00 might not be enough depending on how much is uncovered.**

Bid Item 690.1000 Force Account amount revised. See Addendum Proposal Schedule.

GEOTECHNICAL ENGINEERING EXPLORATION
KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE AND REALIGNMENT OF APPROACHES
FEDERAL AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

W.O. 8190-10 JUNE 24, 2024

Prepared for

WSP

and

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

GEOLABS, INC.
Geotechnical Engineering and Drilling Services

GEOTECHNICAL ENGINEERING EXPLORATION
KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE AND REALIGNMENT OF APPROACHES
FEDERAL AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

W.O. 8190-10 JUNE 24, 2024

Prepared for

WSP

and

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

GERALD Y. SEKI
No. 5635-C

THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION.

SIGNATURE 4-30-26
EXPIRATION DATE
OF THE LICENSE

GEOLABS, INC.
Geotechnical Engineering and Drilling Services
94-429 Koaki Street, Suite 200 • Waipahu, HI 96797

Hawaii • California

GEOLABS, INC.

Geotechnical Engineering and Drilling Services

June 24, 2024
W.O. 8190-10

Mr. Darin Chinen
WSP
American Savings Bank Tower
1001 Bishop Street, Suite 2400
Honolulu, HI 96813

Dear **Mr. Chinen:**

Geolabs, Inc. is pleased to submit our report entitled "Geotechnical Engineering Exploration, Kawaihae Road, Replacement of Waiaka Bridge and Realignment of Approaches, Federal Aid Project No. BR-NH-019-1(045), District of South Kohala, Island of Hawaii," prepared for the design of the project.

Our work was performed in general accordance with the scope of services outlined in our fee proposal dated January 30, 2023.

Please note that the soil and rock samples recovered during our field exploration (remaining after testing) will be stored for a period of two months from the date of this report. The samples will be discarded after that date unless arrangements are made for a longer sample storage period. Please contact our office for alternative sample storage requirements, if appropriate.

Detailed discussion and specific preliminary design recommendations are contained in the body of this report. If there is any point that is not clear, please contact our office.

Very truly yours,

GEOLABS, INC.

Gerald Y. Seki, P.E.
Vice President

GS:GB:as

94-429 Koaki Street, Suite 200 • Waipahu, Hawaii 96797
Telephone: (808) 841-5064 • E-mail: hawaii@geolabs.net

Hawaii • California

GEOTECHNICAL ENGINEERING EXPLORATION
KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE AND
REALIGNMENT OF APPROACHES
FEDERAL AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII
W.O. 8190-10 JUNE 24, 2024

TABLE OF CONTENTS

GEOTECHNICAL ENGINEERING EXPLORATION
KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE AND
REALIGNMENT OF APPROACHES
FEDERAL AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII
W.O. 8190-10 JUNE 24, 2024

SUMMARY OF FINDINGS AND RECOMMENDATIONS

The two borings drilled at the new bridge location generally encountered fill materials extending to depths of about 1 and 9 feet below the existing ground/pavement surface. The fill materials consisted of medium dense to dense silty gravel and gravelly cobbles with some boulders. Below the fill materials, volcanic ash consisting of very stiff sandy silt, extending to a depth of about 3 feet below the existing ground surface, and clinker, extending to a depth of about 9 feet below the existing ground surface, were encountered at the east side of the bridge. The fill materials and clinker were underlain by hard to very hard basalt formation interbedded with clinker (medium dense sandy gravel) extending to the maximum depth explored of about 51.5 feet below the existing ground surface. We did not encounter groundwater at the time of our field exploration.

Based on the materials encountered in the two borings drilled for the replacement bridge, high-quality basalt rock formation was encountered at a depth of about 9 feet below the existing ground/pavement surface, which corresponds to an elevation of about +2,409 feet MSL. Since the basalt rock has a Rock Quality Designation (RQD) of more than 50 percent, the rock may be considered a “non-erodible” surface and should not be affected by scour. Therefore, we believe the replacement bridge may be supported on shallow foundations provided the bottom of the footings extends down to the slightly to moderately fractured basalt rock formation encountered at an elevation of about +2,409 feet MSL or deeper. The following bearing capacity values may be used to evaluate the bearing support of the planned replacement bridge structure based on Load and Resistance Factor Design (LRFD) methods.

- Extreme Event Limit State = 60,000 psf
- Strength Limit State = 27,000 psf
- Service Limit State = 20,000 psf

Voids and/or cavities commonly exist in basalt formation. Therefore, a cavity probing and grouting program at the bridge abutment foundation locations should be conducted during construction to reduce the potential for loss of foundation support resulting from the collapse of cavities below the foundation. The text of this report should be referred to for detailed discussions and specific geotechnical recommendations.

END OF SUMMARY OF FINDINGS AND RECOMMENDATIONS

SECTION 1. GENERAL

This report presents the results of our geotechnical engineering exploration performed for the proposed *Kawaihae Road, Replacement of Waiaka Bridge and Realignment of Approaches* project, located in the District of South Kohala on the Island of Hawaii. The project location and general vicinity are shown on the Project Location Map, Plate 1.

This report summarizes the findings and geotechnical recommendations based on data from our borings and laboratory testing performed for the proposed project. The findings and recommendations presented herein are subject to the limitations noted at the end of this report.

1.1 Project Considerations

The project site is located at the intersection of Kawaihae Road and Kohala Mountain Road in the District of South Kohala on the Island of Hawaii. Waiaka Bridge is located to the east of this intersection.

We understand that the project consists of improvements to the intersection and the replacement of the Waiaka Bridge. Based on the information provided, the existing approaches at the intersection of Kawaihae Road and Kohala Mountain Road provide limited site distance for the southbound approach of Kohala Mountain Road and the eastbound left turn from Kawaihae Road. Therefore, the improvements would consist of realigning the approaches to provide better site distance.

In addition, the improvements would consist of replacing the existing bridge due to the bridge having a National Bridge Inventory Standards Inspection Rating of 26, which corresponds to a functionally obsolete bridge. Waiaka Bridge does not have adequate lane and shoulder widths, resulting in traffic congestion and delays. The replacement bridge will be designed to current State and Federal design standards to reduce traffic congestion and delays. We understand that the new bridge will be a single-span bridge supported by abutments located on the stream banks.

A temporary bridge and roadway are planned during construction of the new bridge. The temporary bridge and roadway will be located to the north of the new bridge.

1.2 Purpose and Scope

The purpose of our exploration is to obtain an overview of the subsurface conditions at the site to develop a soil/rock data set to formulate geotechnical engineering recommendations for the proposed bridge project. The work was performed in general accordance with our fee proposal dated January 30, 2023. In order to accomplish this, we conducted the following tasks and work efforts:

1. Application for excavation permits from the applicable agencies by our engineer.
2. Marking boring locations and utility clearances by our engineer.
3. Coordination of boring stakeout and utility clearances by our engineer.
4. Develop traffic control plans and provide traffic control and safety devices during our field exploration.
5. Mobilization/demobilization of our drilling rig currently on the Island of Hawaii, water truck, and two operators from Honolulu to the project site and back.
6. Drilling and sampling six borings extending to depths of about 10.1 to 52.5 feet below the existing ground surface. Obtaining three bulk samples for R-Value testing.
7. Coordination of the field exploration and logging of the borings by our geologist.
8. Laboratory testing of selected samples obtained during the field exploration as an aid in classifying the materials and evaluating their engineering properties.
9. Analyses of the field and laboratory data to formulate geotechnical recommendations for the proposed project.
10. Preparation of a formal report summarizing our work on the project and presenting our findings and preliminary recommendations.
11. Coordination of our overall work on the project by our project engineer.

12. Quality assurance of our work and client/design team consultation by our principal engineer.

13. Miscellaneous work efforts, such as drafting, word processing, and clerical support.

Detailed descriptions of our field exploration and Logs of Borings are provided in Appendix A. Results of the laboratory tests performed on selected soil samples are presented in Appendix B. Photographs of the core samples retrieved from our field exploration are presented in Appendix C. The pavement analyses are presented in Appendix D. Boring logs from our report entitled “Preliminary Geotechnical Engineering Exploration, Kawaihae Road – Waiaka Bridge Replacement and Realignment of Approaches, District of South Kohala, Island of Hawaii, dated March 8, 2023, are presented in Appendix E.

END OF GENERAL

SECTION 2. SITE CHARACTERIZATION

2.1 Regional Geology

The Island of Hawaii is the largest island in the Hawaiian Archipelago and covers an area of approximately 4,000 square miles. The island was formed by the activity of the following five shield volcanoes: Kohala (long extinct), Mauna Kea (activity during recent geologic time), Hualalai (last erupted in 1801 – 1803), and Mauna Loa and Kilauea (both still active).

The project site is situated on the southern flank of Kohala Mountain, which has formed the northern portion of the island. The site is underlain by basaltic lava flows of the Hawi Volcanic Series of Kohala Mountain, which were deposited during the Pleistocene Epoch (Stearns and Macdonald, 1946). The Hawi Volcanic Series is typically composed of basaltic lava flows that are overlain by a relatively thin layer of palagonitized ash, locally referred to as Pahala Ash. The volcanic ash soil at the project site differs from Pahala Ash found in other portions of the Island of Hawaii in that the in-situ moisture content is generally lower, and the soil exists in a dry friable state.

The lava formation at the project site appears to be of a’a and pahoehoe basalt type flows, which spread and ponded as they approached the ocean. A'a lava is typically characterized by a porous, rough, and irregular flow surface resembling a jagged accumulation of rock fragments, including cobbles and boulders. Typically, a more dense and layered lava rock material is contained within the lava flow core. Pahoehoe lava is characterized by a smooth, rope-like or billowy surface and an internal structure of vesicular (porous) rock. Cavities are commonly encountered in pahoehoe lavas. These cavities were formed when the lava was still in a molten state and represented both lava tubes (intra-flow cavities) and blisters and pockets (inter-flow cavities). Lava tubes are formed when molten lava drains from the cooling flow, leaving a hollow tube-like structure, which may extend for a large distance longitudinally along the flow. Inter-flow cavities are generally smaller in horizontal extent.

2.2 Site Description

The project site is located at the intersection of Kawaihae Road and Kohala Mountain Road in the District of South Kohala on the Island of Hawaii. To the east of this intersection is Waiaka Bridge, which crosses the Keanuiomano Stream. The approximate location of the project site is shown on the Site Plan, Plate 2.

The existing intersection is a three-way intersection with Kohala Mountain Road (Route 250) aligned in the north-south direction and Kawaihae Road (Route 19) aligned in the east-west direction. Kohala Mountain Road terminates at the intersection.

Kohala Mountain Road is a two-lane, undivided roadway consisting of asphaltic concrete pavement. The existing pavement surface elevations of Kohala Mountain Road within the project limits range from about +2,416 (at the intersection) to +2,425 feet Mean Sea Level (MSL) (at the northern project limits).

Kawaihae Road is a two-lane, undivided roadway consisting of asphaltic concrete pavement. The existing pavement surface elevations of Kawaihae Road within the project limits range from about +2,408 (at the western project limits) to +2,423 feet MSL (at the eastern project limits).

The existing Waiaka Bridge crosses over the Keanuiomano Stream. In general, most of the stream area was dry at the time of our field exploration. Based on our observations, the stream bed surface consisted of basalt rock. The existing Waiaka Bridge is a two-span bridge supported by abutments at a center pier. A wooden pedestrian walkway was observed on the north side of the bridge. Utility pipes were observed hanging on the south side of the bridge.

2.3 Subsurface Conditions

The subsurface conditions at the project site were explored by drilling and sampling six borings, designated as Boring Nos. 101 through 106, extending to depths ranging from about 10.1 to 52.5 feet below the existing pavement/ground surface. The approximate boring locations are shown on the Site Plan, Plate 2.

Boring No. 101 was drilled on Kohala Mountain Road, further to the northwest of the west side bridge abutment of the existing bridge. Boring No. 102 was drilled on Kawaihae Road, further to the east of the east side abutment of the existing bridge. The borings generally encountered 10 to 14 inches of asphaltic concrete underlain by dense silty sand fill, volcanic ash (stiff to very stiff clayey silt) and clinker (dense silty gravel and stiff to very stiff clayey silt) extending to depths of about 6.5 and 10.5 feet below the existing pavement surface. The clinker encountered at Boring No. 101 was underlain by closely fractured, medium hard to hard welded clinker extending to a depth of about 13.5 feet below the existing ground surface. The clinker and welded clinker were underlain by hard to very hard basalt formation extending to the maximum depth explored of about 52.5 feet below the existing pavement surface. A generalized geologic cross-section along the new bridge alignment is shown on Plate 3.1.

Boring Nos. 103 and 104 were drilled along the alignment of the temporary bridge. The borings generally encountered fill (very stiff clayey silt) and volcanic ash (stiff to very stiff clayey/sandy silt) extending to depths of about 3 to 4 feet below the existing ground surface. Below the fill and volcanic ash, dense clinker and medium hard to hard welded clinker were encountered to about 7 to 16.5 feet in depths. The clinker and welded clinker were underlain by hard to very hard basalt formation with the clinker layer extending to the maximum depth explored of about 52.5 feet below the existing ground surface. A generalized geologic cross-section along the temporary bridge alignment is shown on Plate 3.2.

Two shallow borings, designated as Boring Nos. 105 and 106, were drilled to obtain subsurface information along Kohala Mountain Road and at the new intersection. In general, the borings encountered 5 to 9 inches of asphaltic concrete over fill and volcanic ash extending to a depth of about 4 feet below the existing pavement surface. The fill and volcanic ash consisted of dense silty gravel and stiff to very stiff clayey silt, respectively. Below the fill and volcanic ash, the borings encountered weathered clinker and clinker consisting of dense to very dense silty sand/gravel and gravelly cobbles extending to depths of about 10.1 to 10.25 feet below the existing pavement surface.

We did not encounter groundwater at the time of our field exploration. However, it should be noted that water levels may vary with stream flow conditions, seasonal rainfall, time of year, and other environmental factors.

Boring information at the site is also contained in our report entitled “Preliminary Geotechnical Engineering Exploration, Kawaihae Road – Waiaka Bridge Replacement and Realignment of Approaches, District of South Kohala, Island of Hawaii,” dated March 8, 2023. The locations of these borings are shown on the Site Plan, Plate 2, and the logs of borings are included in Appendix E.

Detailed descriptions of our field exploration methodology and the Logs of Borings are presented in Appendix A. Results of the laboratory tests performed on selected soil samples obtained from our field exploration are presented in Appendix B. Photographs of the core samples retrieved from our field exploration are presented in Appendix C. The pavement analyses are presented in Appendix D. Logs of borings from our report entitled “Preliminary Geotechnical Engineering Exploration, Kawaihae Road – Waiaka Bridge Replacement and Realignment of Approaches, District of South Kohala, Island of Hawaii,” dated March 8, 2023, are presented in Appendix E.

2.4 Seismic Design Parameters

Based on the Load and Resistance Factor Design (LRFD) Bridge Design Specifications, 9th Edition (2020), the project site may be subject to seismic activity and seismic design considerations will need to be addressed. The following subsections provide discussions on the seismicity, soil profile type for seismic design, and the potential for liquefaction at the project site.

2.4.1 Earthquakes and Seismicity

Generally, earthquakes that occur throughout the world are caused by shifts in the tectonic plates. In contrast, earthquake activity in Hawaii is linked primarily to volcanic activity. Therefore, earthquake activity in Hawaii generally occurs before or during volcanic eruptions. In addition, earthquakes may result from the underground movement of magma that comes close to the surface but does not erupt. The Island of Hawaii experiences thousands of earthquakes each year, but most are so small that they can only be detected by sensitive instruments. However, some of the earthquakes are strong enough to be felt, and a few causes minor to moderate damage.

In general, earthquakes associated with volcanic activity are most common on the Island of Hawaii. Earthquakes that are directly associated with the movement of magma are concentrated beneath the active Kilauea and Mauna Loa Volcanoes on the Island of Hawaii. Because the majority of the earthquakes in Hawaii (over 90 percent) are related to volcanic activity, the risk of seismic activity and degree of ground shaking diminishes with increased distance from the active volcanoes located in the southern portion of the Island of Hawaii.

The Island of Hawaii has experienced numerous earthquakes greater than Magnitude 6 (M6+), including the October 15, 2006 earthquakes. Based on information obtained from the United States Geological Survey (USGS) Bulletin 2006, the following is a list of some destructive earthquakes that have occurred on the Island of Hawaii since 1868.

DATE	LOCATION	MAGNITUDE
March 28, 1868	South Hawaii	7.0
April 2, 1868	South Hawaii	7.9
October 5, 1929	Hualalai	6.5
August 21, 1951	Kona	6.9
April 26, 1973	North Hilo	6.2
November 29, 1975	Kalapana	7.2
November 16, 1983	Kaoiki	6.7
June 25, 1989	Kalapana	6.2
October 15, 2006	Kiholo Bay/Hawi	6.7 / 6.0
May 4, 2018	Leilani Estates	6.9
October 10, 2021	Naalehu	6.2

It should be noted that several of the significant earthquakes on the Island of Hawaii have occurred on the north and west sides in the past 100 years, including two earthquakes greater than Magnitude 6 in 1929 and 1951. In addition, the

October 15, 2006 earthquakes occurred in the northwestern portion of the island. Therefore, it may be concluded that the western side of the Island of Hawaii could experience moderate to severe earthquakes and associated ground shaking, depending on the earthquake's origin.

2.4.2 Soil Profile Type for Seismic Design

Based on the subsurface information obtained from our borings and the geologic setting of the area, the project site may be classified from a seismic analysis standpoint as being a "Very Dense Soil and Soft Rock" site corresponding to a Site Class C soil profile type based on AASHTO 2020 LRFD Bridge Design Specifications, 9th Edition.

Based on the AASHTO 2020 LRFD Bridge Design Specifications, the seismic retrofitted bridge structure will need to be designed based on an earthquake return period of 1,000 years. Based on a 1,000-year return period and the anticipated Site Class, the following seismic design parameters were estimated and may be used for the seismic analysis of the bridge structure planned for the project.

SEISMIC DESIGN PARAMETERS
WAIAKA BRIDGE
AASHTO 2020 LRFD BRIDGE DESIGN SPECIFICATIONS
1,000-YEAR RETURN PERIOD
(~7% PROBABILITY OF EXCEEDANCE IN 75 YEARS)

Parameter	Value
Peak Bedrock Acceleration, PBA (Site Class B)	0.433g
Spectral Response Acceleration (Site Class B), S_S	0.879g
Spectral Response Acceleration (Site Class B), S_1	0.346g
Site Class	"C"
Site Coefficient, F_{pga}	1.00
Site Coefficient, F_a	1.05
Site Coefficient, F_v	1.45
MCE Peak Ground Acceleration, PGA (Site Class C) or A_s	0.433g
Design Spectral Response Acceleration, S_{DS}	0.921g
Design Spectral Response Acceleration, S_{D1}	0.503g
Seismic Design Category	"D"

2.4.3 Liquefaction Potential

Soil liquefaction is a condition where saturated cohesionless soils located near the ground surface undergo a substantial loss of strength due to the build-up of excess pore water pressures resulting from cyclic stress applications induced by earthquakes. In this process, when the loose saturated sand deposit is subjected to vibration (such as during an earthquake), the soil tends to densify and decrease in volume causing an increase in pore water pressure. If drainage is unable to occur rapidly enough to dissipate the build-up of pore water pressure, the effective stress (internal strength) of the soil is reduced. Under sustained vibrations, the pore water pressure build-up could equal the overburden pressure, essentially reducing the soil shear strength to zero and causing it to behave as a viscous fluid. During liquefaction, the soil acquires sufficient mobility to permit both horizontal and vertical movements, and if not confined, will result in significant deformations.

Soils most susceptible to liquefaction are loose, uniformly graded, fine-grained sands and loose silts with little cohesion. The major factors affecting the liquefaction characteristics of a soil deposit are as follows:

FACTORS	LIQUEFACTION SUSCEPTIBILITY
Grain Size Distribution	Fine and uniform sands and silts are more susceptible to liquefaction than coarse or well-graded sands.
Initial Relative Density	Loose sands and silts are most susceptible to liquefaction. Liquefaction potential is inversely proportional to relative density.
Magnitude and Duration of Vibration	Liquefaction potential is directly proportional to the magnitude and duration of the earthquake.

Based on the subsurface conditions encountered, the phenomenon of soil liquefaction is not a design consideration for this project site. The risk for potential liquefaction is low based on the subsurface conditions encountered (medium dense to dense fill, dense to very dense clinker, and very stiff volcanic ash overlying hard to very hard basalt rock formation within the depths of our borings).

END OF SITE CHARACTERIZATION

SECTION 3. DISCUSSION AND RECOMMENDATIONS

The two borings drilled to obtain subsurface information for the design of the replacement bridge generally encountered fill materials extending to depths of about 1 and 9 feet below the existing ground/pavement surface. The fill materials consisted of medium dense to dense silty gravel and gravelly cobbles with some boulders. Below the fill materials, volcanic ash consisting of very stiff sandy silt extending to a depth of about 3 feet below the existing ground surface and clinker extending to a depth of about 9 feet below the existing ground surface was encountered at the east side of the bridge. The fill materials and clinker were underlain by hard to very hard basalt formation interbedded with clinker (medium dense sandy gravel) extending to the maximum depth explored of about 51.5 feet below the existing ground surface. We did not encounter groundwater in the borings at the time of our field exploration.

Based on the materials encountered at the site, high-quality basalt rock formation was encountered at a depth of about 9 feet below the existing ground surface, which corresponds to an elevation of about +2,409 feet MSL. Since the basalt rock has a Rock Quality Designation (RQD) of more than 50 percent, the rock may be considered a “non-erodible” surface and should not be affected by scour. Therefore, we believe the replacement bridge may be supported on shallow foundations provided that the bottom of the footings extends down to the slightly to moderately fractured basalt rock formation encountered at an elevation of about +2,409 feet MSL or deeper.

Voids and/or cavities commonly exist in the basalt formation. Therefore, a cavity probing and grouting program at the bridge abutment foundation locations should be conducted during construction to reduce the potential for loss of foundation support resulting from the collapse of cavities below a footing. We recommend drilling a 3-inch diameter probe hole extending to a depth of at least 10 feet below the planned bottom of footing elevation for every 100 square feet of foundation area or at 10 feet on center along the abutment foundations. We recommend utilizing a low strength sand-cement grout mixture or Controlled Low Strength Material (CLSM) with a slump range of 6 to 9 inches to backfill the probe holes and cavities discovered at the site. The grout/CLSM should be injected at low to moderate pressures.

Detailed discussions of these items and our geotechnical recommendations for the planning and preliminary design of the project are presented in the following sections.

3.1 Scour Potential

Scour is the result of the erosive action of flowing water, excavating and carrying away material from the bed and banks of the stream. Total scour over a period of time generally consists of three components.

1. Aggregation and Degradation
2. Contraction Scour
3. Local Scour

The rates of scour depend on a number of factors, such as the shape and dimensions of a pier or abutment, depth of flow, velocity of approach flow, size and gradation of stream bed material, and bed configuration.

One of the factors affecting the scour depth is the grain size characteristic of the stream bed material. The median diameter of the stream bed material (D_{50}) in conjunction with the depth of flow and flow velocity, is used to calculate the fall velocity of stream bed materials in scour analysis. Based on the materials encountered in the two borings drilled for the replacement bridge, it is anticipated that high-quality basalt rock formation will be encountered at depths of about 7 and 17 feet below the existing ground surface. The following table presents the approximate elevation of where the high-quality basalt rock was encountered in the borings.

Boring Identification	**Elevation of High-Quality Basalt** (Feet MSL)
B-1 (Replacement Bridge)	+2,409
B-2 (Replacement Bridge)	+2,409
B-101 (Replacement Bridge)	+2,403
B-102 (Replacement Bridge)	+2,410
B-103 (Temporary Bridge)	+2,403
B-104 (Temporary Bridge)	+2,410

Based on the guidelines on scour potential by the Federal Highway Administration, the basalt rock formation starting at these elevations may be considered a “non-erodible” surface since its rock classification has a Rock Quality Designation (RQD) of more than 50 percent and, therefore, should not be affected by scour.

As a result of the high-quality rock formation encountered at the site, we believe that countermeasures to reduce the potential for scour would not be required for the replacement and temporary bridge foundations, provided that the bridge foundations bear directly on the high-quality basalt rock formation encountered in the borings.

It should be noted that areas exposing on-site or new fills, volcanic ash, clinker or welded clinker may be subjected to scour and may require countermeasures to reduce the potential for scour.

3.2 Replacement Bridge Foundations

Based on the design criteria provided by the State of Hawaii, Department of Transportation, Highways Division, the replacement bridge foundations will be designed based on the LRFD method.

As mentioned previously, the replacement bridge will be a single-span bridge supported on two abutments. Based on our field exploration results, we believe that the replacement bridge may be supported on shallow foundations provided that the bottom of the foundations extends down to the slightly to moderately fractured basalt rock formation encountered at an elevation of about +2,409 feet MSL or deeper. The following bearing capacity values may be used to evaluate the bearing support of the planned replacement bridge structure based on LRFD methods.

ESTIMATED BEARING CAPACITIES FOR BRIDGE FOUNDATION DESIGN

Subgrade Material	**Limit State**	**Bearing Capacity** (psf)
Basalt Formation	Extreme Event	60,000
	Strength	27,000
	Service	20,000

Foundations next to utility trenches or easements should be embedded below a 45-degree imaginary plane extending upward from the bottom edge of the utility trench, or the footings should extend to a depth as deep as the inverts of the utility lines. This requirement is necessary to avoid surcharging adjacent below-grade structures with additional structural loads and to reduce the potential for appreciable foundation settlement.

Based on a service limit state bearing pressure of 20,000 pounds per square foot (psf), we estimate foundation settlements under the anticipated design loads for footings bearing directly on the basalt rock formation, as recommended herein, to be less than 0.125 inches. Differential settlements between the abutment footings supported on the basalt formation should be on the order of about 0.016 inches.

Lateral loads acting on the bridge structure may be resisted by friction developed between the bottom of the foundation and the bearing materials and by passive earth pressure acting against the near-vertical faces of the foundation system. A coefficient of friction of 0.75 and 0.6 may be used to evaluate the sliding resistance of foundations bearing on the hard basalt rock for the extreme event limit state and strength limit state, respectively. Resistance due to passive earth pressure for footings embedded in the hard basalt rock may be estimated using a rectangular pressure distribution of 20,000 psf for the extreme event limit state. Passive pressure with a rectangular pressure distribution of 10,000 psf may be used for the strength limit state of footings embedded in the basalt rock formation.

To reduce the seismic loading to the abutment, the excavation behind the abutment should be cut to one and one-half horizontal to one vertical (1.5H:1V) inclination and the area behind the abutment and the cut slope should be backfilled with CLSM. The inertial force of the CLSM backfill should be considered in the seismic analysis.

For lateral loads imposed on the abutments, the stiffness of the abutment fill, which consists of CLSM, will generally be mobilized prior to the lateral resistance of the spread footings. A stiffness spring equal to approximately 4 kips per square foot (ksf) per inch of deflection may be used in resisting lateral loads.

Additional resistance to lateral loads may be provided by shear resistance between the sides of the footings and the basalt rock surface. The side shear resistance of the footings should not be used for the strength and/or service limit state; however, a side shear resistance of up to 2,000 psf may be used for the extreme event limit state only. It should be noted that the above values for lateral load resistance assume that the concrete for the footings is cast neat against the basalt rock formation. In addition, excavations for the footings in basalt rock formation (including fractured rock) should be kept to near vertical (0.5H:1V or steeper). Inadvertent over-excavation by the contractor should be cleaned of loose and fractured rock, and the resulting void space should be backfilled with concrete in order to develop the high lateral load resistance values provided above.

Considering the high axial and lateral bearing values provided for the design of the bridge structure, confirmation and evaluation of the exposed bearing materials during construction will be necessary. Therefore, it is imperative that the footing excavations be observed by a representative from Geolabs prior to the placement of reinforcing steel or concrete to confirm the foundation bearing conditions and the required embedment depths.

3.3 Abutment Backfill

We believe that CLSM backfill may be utilized to reduce the seismic loading to the abutment for the project. The abutment backfill utilizes CLSM to stabilize the abutment structure backfill with a self-supporting mass. The following guidelines should be followed for construction:

- CLSM should be placed behind the abutment wall in front of the 1.5H:1V cut slope.
- Horizontally level benches should be excavated for the placement of CLSM. Each bench should be a maximum of 2 feet in height.
- CLSM should be placed in a maximum 4-foot lift thickness. Subsequent lifts of CLSM should be placed only after the previously placed CLSM has achieved adequate strength as a self-supporting mass.
- CLSM should have a slump of 6 to 8 inches during placement.
- Areas outside of the 1.5H:1V envelope may consist of structural fill (6-inch minus).

Because the CLSM stabilizes the backfill behind the abutment walls, we believe the abutment walls would not need to be designed for static and dynamic lateral earth pressures. However, the retaining structure should be designed to resist the inertial forces of the CLSM mass due to seismic loading (A_s = 0.433g).

3.4 Concrete Barrier Walls

We understand that concrete barrier walls are planned at the east side bridge abutment. Based on the information provided, the concrete barrier walls would likely be embedded in new or existing fill materials. The following guidelines may be used to design the concrete barrier walls.

3.4.1 Concrete Barrier Wall Foundations

For foundations bearing on the new or existing fill materials, bearing values of up to 12,000 and 5,400 psf may be used to evaluate the extreme event limit state and strength limit state, respectively. Footings should be embedded at a minimum depth of 24 inches below the lowest adjacent grade.

For sloping ground conditions, the bottom of the footing should extend deeper to obtain a minimum 6-foot setback distance measured horizontally from the outside edge of the footing to the face of the slope. Wall footings oriented parallel to the direction of the slope should be constructed in stepped footings.

In general, the exposed subgrades should be moisture-conditioned to above the optimum moisture and recompacted to at least 90 percent relative compaction to provide a relatively firm and smooth bearing surface. Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same soil established in accordance with ASTM D1557 (AASHTO T-180). Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density.

Volcanic ash, soft and/or loose materials encountered at the bottom of the concrete barrier wall footing excavations should be over-excavated to expose the underlying dense materials. The over-excavation may be backfilled with select granular fill compacted to a minimum of 90 percent relative compaction, or the bottom of the footing may be extended down to the underlying competent materials.

Based on a service limit state bearing pressure of 4,000 psf, we estimate that wall footing settlement would be on the order of about 1 inch with differential settlement on the order of about 0.5 inch or less.

Lateral loads acting on the concrete barrier walls may be resisted by friction developed between the bottom of the footing and the bearing materials and by passive earth pressure acting against the wall. A coefficient of friction of 0.63 and 0.5 may be used to evaluate the sliding resistance of foundations bearing on the granular fill materials for the extreme event limit state and strength limit state, respectively. Resistance due to passive earth pressure for footings embedded in the fill materials may be estimated using an equivalent fluid pressure of 350 pounds per square foot per foot of depth (pcf) for the extreme event limit state. Passive earth pressure with an equivalent fluid pressure of 175 pcf may be used for the strength limit state of footings embedded in fill materials.

These values assume that the concrete for the foundation is cast neatly against the soils. Otherwise, the soils around the foundation should be well-compacted (minimum of 90 percent relative compaction). Unless covered by pavements or slabs, the passive pressure resistance in the upper 12 inches below the finished grade should be neglected.

3.4.2 Lateral Earth Pressures

The concrete barrier walls should be designed to resist the lateral earth pressures due to the adjacent soils and surcharge effects. The recommended lateral earth pressures for the design of walls, expressed in equivalent fluid pressures of pounds per square foot per foot of depth (pcf), are presented in the following table for retaining wall backfills consisting of granular fill material conforming to Type A Structure Backfill Material of Section 703.20 of the HSS. These lateral earth pressures do not include hydrostatic pressures that might be caused by groundwater trapped behind the structures.

LATERAL EARTH PRESSURES FOR DESIGN OF RETAINING WALLS		
Backfill Condition	**Active** (pcf)	**At-Rest** (pcf)
Level	34	54

We recommend compacting the backfill behind retaining walls to between 90 and 95 percent relative compaction. Over-compaction of the retaining wall backfill should be avoided. The backfill materials should be moisture-conditioned to above the optimum moisture content prior to being utilized as backfill materials.

In general, the at-rest condition should be used for retaining walls where the top of the structure is restrained from movement prior to backfilling of the wall. The active condition should be used only for gravity retaining walls and retaining structures that are free to deflect by as much as 0.5 percent of the wall height.

Surcharge stresses due to areal surcharges, line loads, and point loads within a horizontal distance equal to the depth of the retaining walls should be considered in the design. For uniform surcharge stresses imposed on the loaded side of the retaining wall, a rectangular distribution with a uniform pressure equal to 44 percent of the vertical surcharge pressure acting on the entire height of the wall, which is restrained, may be used in the design. For retaining walls that are free to deflect (cantilever), a rectangular distribution equal to 28 percent of the vertical surcharge pressure acting over the entire height of the wall may be used for the design.

3.4.3 Dynamic Lateral Earth Pressures

Dynamic lateral earth forces due to seismic loading will need to be considered in the design of the concrete barrier walls based on LRFD design methods. Seismic loading (A_s = 0.433g) was used to estimate the dynamic lateral earth pressures. The table below summarizes the dynamic lateral earth forces acting on the retaining structure in the event of an earthquake.

DYNAMIC LATERAL EARTH FORCES FOR RETAINING WALLS	
Lateral Movement (inches)	**Dynamic Lateral Earth Forces** (H^2 pounds per linear foot)
	Level Backfill
2	8.8

It should be noted that the above table only applies to level backfill conditions, where H is the height of the wall in feet. The resultant force should be assumed to act through the mid-height of the wall. The above dynamic lateral earth force is in addition to the static lateral earth pressures provided in the previous table. An appropriately reduced factor of safety may be used when dynamic lateral earth pressures are accounted for in the design of the retaining wall.

3.4.4 Drainage

Retaining walls should be well drained to reduce the potential for the build-up of hydrostatic pressures. A typical drainage system would consist of a 12-inch wide zone of permeable material, such as drain rock (AASHTO M43 Size No. 67), placed adjacent to the wall with a perforated pipe (perforations facing down) at the base of the wall discharging to an appropriate outlet or weepholes. As an alternative, a prefabricated drainage product, such as MiraDrain or EnkaDrain, may be used instead of the drainage material. The prefabricated drainage product should also be hydraulically connected to a perforated pipe at the base of the wall.

Backfill behind the permeable drainage zone should consist of granular structural backfill material. Unless covered by concrete slabs or pavements, the upper 12 inches of backfill should consist of relatively impervious material to reduce the potential for water infiltration behind the walls. In addition, the backfill below the drainage outlet (or weepholes) should consist of the relatively impervious material to reduce the potential for water infiltration into the footing subgrade. The relatively impervious material should be compacted to no less than 90 percent relative compaction.

3.5 Temporary Bridge Structure

Based on the information provided, a temporary detour bridge will be constructed for the project. Structural details of the temporary structure were not available at the time this report was prepared. However, we anticipate that the temporary structure will be a single-span Acrow Panel steel bridge with a length on the order of about 95 feet.

Based on our field exploration results, we believe that the temporary bridge may be supported on shallow foundations bearing on clinker or weathered clinker. We understand that the design of the temporary bridge will be based on LRFD methods. Therefore, the recommended values presented in the "Concrete Barrier Walls" section may be used to evaluate the bearing support, sliding resistance, and passive pressure resistance of the temporary bridge foundations.

3.6 Foundation Probing

Based on our experience in the area, voids and/or cavities commonly exist in the basalt formation in the vicinity. To reduce the potential for loss of foundation support resulting from the collapse of cavities below a footing, we recommend implementing a program of cavity probing and grouting at the replacement and temporary bridge abutment foundation locations during construction.

For estimating purposes, we recommend drilling a probe hole for every 100 square feet of foundation area or at 10 feet on center along the abutment foundations. The probe holes should be at least 3 inches in diameter and should extend to a depth of at least 10 feet below the planned bottom of footing elevation. If cavities and/or voids are encountered or suspected during the probing operation, additional probe holes should be drilled at closer spacing to aid in delineating the vertical and lateral extent of the cavity and/or void. The probe holes and cavities discovered should be backfilled with sand-cement grout injected at low to moderate pressures. We recommend utilizing a low strength sand-cement grout mixture with a slump range of 6 to 9 inches for the grouting operations. As an alternative to sand-cement grout, CLSM with a slump range of 6 to 9 inches may also be used for the grouting operations.

3.7 Site Grading

At the on-set of earthwork, areas within the contract grading limits should be cleared and grubbed thoroughly. Vegetation, debris, deleterious materials, existing structures to be demolished, and other unsuitable materials should be removed and disposed of properly off-site to reduce the potential for contaminating the excavated materials.

Soft and yielding areas encountered during clearing and grubbing below areas designated to receive fill and/or future improvements should be over-excavated to expose firm natural material, and the resulting excavation should be backfilled with well-compacted fill. The excavated soft soils should not be reused as fill materials and should be properly disposed of off-site.

After clearing and grubbing, the exposed subgrades and areas designated to receive fills should be scarified to a depth of about 8 inches, moisture-conditioned to above the optimum moisture content, and recompacted to a minimum of 90 percent relative compaction. Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density as determined by ASTM D1557. Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density.

Prior to fill placement and in areas where the cut subgrades expose basalt rock, the subgrades should be proof-rolled with a minimum 10-ton vibratory roller or similar heavy construction equipment for a minimum of 6 passes to help detect and collapse near-surface cavities. Loose areas or cavities disclosed during proof-rolling operations should be opened, cleaned of debris, and backfilled with properly compacted fill or concrete.

In general, the excavated on-site materials should be suitable for use as general fill materials, provided that the maximum particle size is less than 6 inches in the largest dimension. The excavated volcanic ash may be used as general fill provided that the volcanic ash is combined with granular/rocky material resulting in a material that contains less than 30 percent (by dry weight) particles passing the No. 200 sieve. General fills and backfills should be moisture-conditioned to above the optimum moisture content, placed in level lifts not exceeding 8 inches in loose thickness, and compacted to at least 95 percent relative compaction.

Imported materials, if required, should consist of select granular fill such as crushed basalt. The select granular fill should be well-graded from coarse to fine with particles no larger than 3 inches in the largest dimension. The material should have a California Bearing Ratio value of 20 or higher and a swell potential of 1 percent or less when tested in accordance with AASHTO T193 (ASTM D1883). The material should also contain between 10 and 30 percent particles passing the No. 200 sieve. Imported fill materials should be tested for conformance with these recommendations prior to delivery to the project site for the intended use. Select granular fills should be moisture-conditioned to above the optimum moisture content, placed in level lifts not exceeding 8 inches in loose thickness, and compacted to at least 95 percent relative compaction. Imported fill materials should be tested and approved prior to delivery to the project site for the intended use.

For backfill behind the abutment structure, the backfill material should consist of well-graded, granular fill material conforming to Type A Structure Backfill Material of Section 703.20 of the HSS. The material should be moisture-conditioned to above the optimum moisture content, placed in level loose lifts not exceeding 8 inches, and compacted to not less than 95 percent relative compaction.

3.8 Cut and Fill Slopes

Based on the subsurface conditions encountered in the borings, it appears that permanent cut slopes near the existing ground surface (within 10 feet of the existing ground surface) would expose the soil-like materials (granular fills, volcanic ash, and clinker). In general, permanent cut slopes exposing the soil-like materials may be designed with a slope inclination of 2H:1V or flatter. Where cut slopes expose the dense basalt formation, the cut slope may be steepened to a slope inclination as steep as 0.5H:1V, if desired. Cavities that may be exposed on the cut slope face should be backfilled and grouted. We recommend that cut slopes exposing soil-like materials be immediately protected by appropriate slope planting or other means to reduce the potential for erosion of the exposed soils.

Permanent fill slopes constructed with either general fill materials or imported fill materials may be designed with a slope inclination of 2H:1V or flatter. Fills placed on slopes steeper than 5H:1V should be keyed and benched into the existing slope to provide stability for the new fill against sliding. The filling operations should start at the lowest point and continue up in level horizontal compacted layers in accordance with the above fill placement recommendations. Fill slopes should be constructed by overfilling and cutting back to the design slope ratio to obtain a well-compacted slope face. Water should be diverted away from the tops of slopes, and slope planting should be provided as soon as possible to reduce the potential for significant erosion of the finished slopes.

3.9 Excavation

We anticipate site grading work consisting of deep cuts will be required for construction of the bridge at each abutment location. Where deep excavations (greater than 5 feet in depth) are planned, temporary shoring or sloping and benching should be implemented for the excavations. Based on the competent subsurface conditions encountered in the borings, we believe that temporary cut slopes for open-cut excavations may be feasible. However, trench walls cut near vertical would require the use of temporary shoring during construction. The contractor should determine the method and equipment to be used for excavation, subject to practical limits and applicable local safety requirements. Shoring design and installation should be the responsibility of the contractor.

Based on our field exploration and the on-site fills, volcanic and clinker materials may be excavated with normal heavy excavation equipment, such as backhoes, and ripping with bulldozers. Our laboratory testing indicated that the unconfined compressive strength of the basalt rock formation encountered at the site ranges from about 5,250 to 33,460 pounds per square inch (psi). The unconfined compressive strength of the welded clinker is about 800 psi. Based on the unconfined compressive strength of the basalt rock formation and welded clinker at the site, we believe that excavations into the basalt rock formation and welded clinker may require the use of hoerams or chipping.

The above discussions regarding the rippability of the materials are based on our experience with basalt rock formations and welded clinker in the area. We recommend encouraging contractors to examine the site conditions and the subsurface data to make their own reasonable and prudent interpretation.

3.10 Pavement Design

Two types of pavement structural sections (flexible and rigid pavements) were considered in the pavement analyses. The flexible pavement section presented herein was generally determined based on the methodology described in Chapter 3 of the revised Pavement Design Manual dated March 2002 prepared by the State of Hawaii, Department of Transportation, Highways Division, Material Testing and Research Branch. The pavement design methodology is based on the Hveem Stabilometer method developed and used by the California Department of Transportation (Caltrans).

The design procedures for the rigid pavement section are generally based on the design procedures described in the Portland Cement Association “Thickness Design for Concrete Highway and Street Pavements.” The following subsections provide discussion of the areas necessary for pavement analyses and design:

- Design Traffic Loading Conditions/Traffic Index
- Design Subgrade Conditions
- Design Pavement Section

3.10.1 Design Traffic Loading Conditions/Traffic Index

Based on the design guidelines from the revised Pavement Design Manual dated March 2002, we believe that the roadway may be classified as a “High Volume Rural” roadway. Therefore, the pavement will need to be designed for a pavement life of 30 years. Traffic information was provided by WSP on September 3, 2021.

We have assumed that completion of the roadway would be in the Year 2023. A growth rate of about 0.5 percent was assumed in our traffic analysis. The following table summarizes the design traffic parameters used in our pavement analyses.

DESIGN TRAFFIC PARAMETERS	
Design Period	30 Years
Average Daily Traffic (ADT)	Vehicles per day
Year 2023 Year 2053	10,265 11,775
24-Hour Truck Traffic	5.9%
Type of Axle	Truck Traffic Distribution
2-axle	67.84%
3-axle	10.39%
4-axle	2.55%
5-axle	18.71%
6-axle	0.49%
7-axle	0.01%

Based on a design period of 30 years, the traffic volume, and the truck distribution information assumed, A Traffic Index (TI) of 11.0 has been determined for the project. Detailed analyses on the TI determination are provided on Plate D-1 in Appendix D.

3.10.2 Design Subgrade Conditions

Based on our field exploration, we anticipate that the pavement subgrade soils would consist of very stiff sandy silt (volcanic ash). Laboratory Resistance (R) value tests performed on near-surface soils obtained from our field exploration indicated that the materials exhibited R-values between approximately 41 and 69. Based on the test results, a design R-value of 44 was adopted in our pavement analyses for the subgrade materials. If site grading exposes soils other than those assumed, additional tests should be performed to confirm and/or revise the recommended pavement sections for actual field conditions.

Based on a design R-value of 44 adopted for the pavement subgrade soils as described above, a corresponding K-value of 125 pounds per square inch per inch of deflection (pci) is obtained from Figure 1-1 of the Pavement Design Manual prepared by the State of Hawaii, Department of Transportation, Highways Division, Material Testing and Research Branch. Based on a total thickness of 6 inches of aggregate base, the design “Subgrade/Base K” value may be increased to 150 pci in accordance with Figure 1-2 of the Pavement Design Manual. It should be noted that 150 pci is the maximum K-value allowed by the Pavement Design Manual.

3.10.3 Design Pavement Section

We understand that an existing drainage system is not present at the project site; therefore, we do not recommend incorporating a permeable drainage layer into the pavement section design since there is no practical way to drain the water that would collect in the subdrains. We have only considered pavement structural sections without permeable drainage layers in our analyses.

Based on the relatively high traffic volume (greater than 10,000 vehicles per day) anticipated along Kawaihae Road at Waiaka Stream Bridge, we believe the asphalt concrete base (ACB) should be used as the base material for the flexible pavement section.

For the purposes of rigid pavement design, a concrete modulus of rupture (MR) of 650 psi was used for the project. In addition, we have assumed aggregate interlock at the concrete pavement joints.

We understand that higher quality material is desired below the AC and PCC pavements to reduce the potential for early pavement failures. Therefore, aggregate base course will be used below the AC and PCC in lieu of aggregate subbase course.

Based on the assumptions presented above, we considered the following two pavement structural sections for use as the new pavements for the project. Detailed analyses and calculations of the pavement design options are presented on Plates D-2 through D-5.

Flexible Pavement

4.0-Inch Asphaltic Concrete
7.0-Inch Asphalt Concrete Base
6.0-Inch Aggregate Base Course (95 Percent Relative Compaction)
17.0-Inch Total Pavement Thickness on Compacted Subgrade

Rigid Pavement

10.0-Inch Portland Cement Concrete
6.0-Inch Aggregate Base Course (95 Percent Relative Compaction)
16.0-Inch Total Pavement Thickness on Compacted Subgrade

An economic analysis was performed on the two pavement design options presented above to evaluate the construction costs of the pavement sections. The results of the economic analyses are presented on Plates D-6 through D-8. Based on our cost comparison of the pavement design options, it appears that a rigid pavement structural section consisting of 10 inches of PCC over 6 inches of AB would result in the most economical pavement design for the design life considered.

However, if it is desired to keep the roadway open during construction and not affect traffic flow for an extended period, we recommend utilizing a flexible pavement section for the new pavement. Therefore, the recommended pavement design section is summarized below.

Recommended Pavement Design Section

4.0-Inch Asphaltic Concrete
7.0-Inch Asphalt Concrete Base
6.0-Inch Aggregate Subbase (95 Percent Relative Compaction)
17.0-Inch Total Pavement Thickness on Compacted Subgrade

We understand that the State of Hawaii, Department of Transportation, Highways Division is directing that the following pavement design section be used for the project.

Pavement Design Section

2.0-Inch Polymer Modified Asphaltic Concrete
9.0-Inch Asphalt Concrete Base
6.0-Inch Aggregate Base Course (95 Percent Relative Compaction)
17.0-Inch Total Pavement Thickness on Permeable Separator on
Compact Subgrade

3.11 Temporary Detour Road

We understand that a temporary detour road will be constructed along the north side of the existing bridge structure to accommodate traffic during the construction of the new replacement bridge structure. We anticipate that the temporary detour road will be in service for about 24 months. Based on a design period of 24 months, the traffic volume, and the truck distribution information provided, a Traffic Index (TI) of 7.5 has been determined for the temporary detour road for the proposed project. Detailed analyses on the Traffic Index Determination for the temporary detour road are presented on Plate D-9 in Appendix D of this report.

We have performed our pavement analysis using a design R-value of 44. Based on the assumptions presented above, we recommend using the following pavement section for the temporary detour road.

Temporary Detour Road – Option A

3.0-Inch Asphaltic Concrete
5.0-Inch Asphalt Concrete Base
8.0-Inch Total Pavement Thickness on Compacted Subgrade

An alternative pavement section, utilizing an aggregate base course instead of an asphalt concrete base, is provided below.

Temporary Detour Road – Option B

3.0-Inch Asphaltic Concrete
10.0-Inch Aggregate Base Course (95 Percent Relative Compaction)
13.0-Inch Total Pavement Thickness on Compacted Subgrade

Detailed analyses and calculations of the pavement design for the temporary detour road are presented on Plates D-10 and D-11 in Appendix D.

3.12 Underground Utilities

We envision underground utility lines may need to be relocated due to the realignment of the approaches. We anticipate most of the trenches for the utility lines will be excavated in the fill, volcanic ash, and clinker. Basalt rock formation may be encountered in the trench excavations where utilities are required to extend to deeper depths.

In general, granular bedding consisting of 6 inches of open-graded gravel (ASTM C33, No. 67 gradation) should be provided below the pipes for uniform bearing support. Free-draining granular materials, such as open-graded gravel (ASTM C33, No. 67 gradation), should be used for the initial trench backfill up to about 12 inches above the pipes. It is critical to use this free-draining material to reduce the potential for the formation of voids below the haunches of pipes and to provide adequate support for the sides of the pipes. The improper backfill material around the pipes and improper placement of the backfill could result in backfill settlement and pipe damage.

The upper portion of the trench backfill from the level 12 inches above the pipes to the top of the subgrade or finished grade should consist of well-graded granular materials less than 6 inches in maximum particle size. The backfill should be moisture-conditioned to above the optimum moisture content, placed in about 8-inch level loose lifts, and mechanically compacted to at least 90 percent relative compaction. Where trenches are located in paved areas, the upper 3 feet of the trench backfill below the pavement grade should be compacted to no less than 95 percent relative compaction.

If the utility installation involves excavation in the basaltic rock formation and will require hard ripping or the use of hoerams, the contractor must exercise care to avoid over-ripping, which would disrupt the structure of the rock formation and result in a potential loss of bearing strength for footings in its vicinity.

3.13 Design Review

Preliminary and final drawings and specifications for the project should be forwarded to Geolabs for review and written comments prior to bid solicitation for construction. This review is necessary to evaluate conformance of the plans and specifications with the intent of the foundation and earthwork recommendations provided herein. If this review is not made, Geolabs cannot be responsible for misinterpretation of our recommendations.

3.14 Post-Design Services/Services During Construction

Geolabs should be retained to provide geotechnical engineering services during construction. The critical items of construction monitoring that require "Special Inspection" include the following:

1. Observation of the foundation excavations
2. Observation of probing and grouting operations
3. Observation of subgrade preparation
4. Observation of fill and backfill placement and compaction

A Geolabs representative should also monitor other aspects of earthwork construction to observe compliance with the design concepts, specifications, or recommendations and to expedite suggestions for design changes that may be required in the event that subsurface conditions differ from those anticipated at the time this report was prepared. Geolabs should be accorded the opportunity to provide geotechnical engineering services during construction to confirm our assumptions in providing the recommendations presented herein.

If the actual exposed subsurface conditions encountered during construction differ from those assumed or considered herein, Geolabs should be contacted to review and/or revise the geotechnical recommendations presented herein.

END OF DISCUSSION AND RECOMMENDATIONS

SECTION 4. LIMITATIONS

The analyses and recommendations submitted herein are based in part upon information obtained from our field borings and laboratory testing. Variations of the subsurface conditions between and beyond the field data points may occur, and the nature and extent of these variations may not become evident until additional field exploration is underway. If variations then appear evident, it will be necessary to re-evaluate the preliminary recommendations presented herein.

The field boring locations indicated herein are approximate, having been estimated by using a hand-held Global Positioning System (GPS) device in the field. Elevations of the field borings were interpolated between the contour lines and spot elevations shown on the Topographic Survey Map transmitted by WSP on October 19, 2022. The physical locations and elevations of the borings should be considered accurate only to the degree implied by the methods used.

The stratification lines shown on the graphic representations of the borings depict the approximate boundaries between soil types and, as such, may denote a gradual transition. Water level data from the borings were measured at the times shown on the graphic representations and/or presented in the text herein. These data have been reviewed and interpretations made in the formulation of this report. However, it must be noted that fluctuation may occur due to variations in rainfall, tides, temperature, and other factors.

This report has been prepared for the exclusive use of WSP and their client, the State of Hawaii, Department of Transportation, Highways Division, for specific application to the proposed *Kawaihae Road, Replacement of Waiaka Bridge and Realignment of Approaches* project in accordance with generally accepted geotechnical engineering principles and practices. No warranty is expressed or implied.

This report has been prepared solely for the purpose of assisting the design engineers in the planning and preliminary design of the project. Therefore, this report may not contain sufficient data or the proper information to serve as a basis for detailed design, preparation of construction cost estimates, or contract bidding. A detailed field exploration program should be implemented to obtain additional information pertaining to the final design of the replacement bridge project.

The owner/client should be aware that unanticipated soil conditions are commonly encountered. Unforeseen subsurface conditions, such as perched groundwater, soft deposits, hard layers, or cavities, may occur in localized areas and may require additional probing or corrections in the field (which may result in construction delays) to attain a properly constructed project. Therefore, a sufficient contingency fund is recommended to accommodate these possible extra costs.

This geotechnical engineering exploration conducted at the project site was not intended to investigate the potential presence of hazardous materials existing at the project site. The equipment, techniques, and personnel used to conduct a geo-environmental exploration differ substantially from those applied in geotechnical engineering.

END OF LIMITATIONS

CLOSURE

The following plates and appendices are attached and complete this report:

-ΩΩΩΩΩΩΩΩΩ-

Respectfully submitted,

GEOLABS, INC.

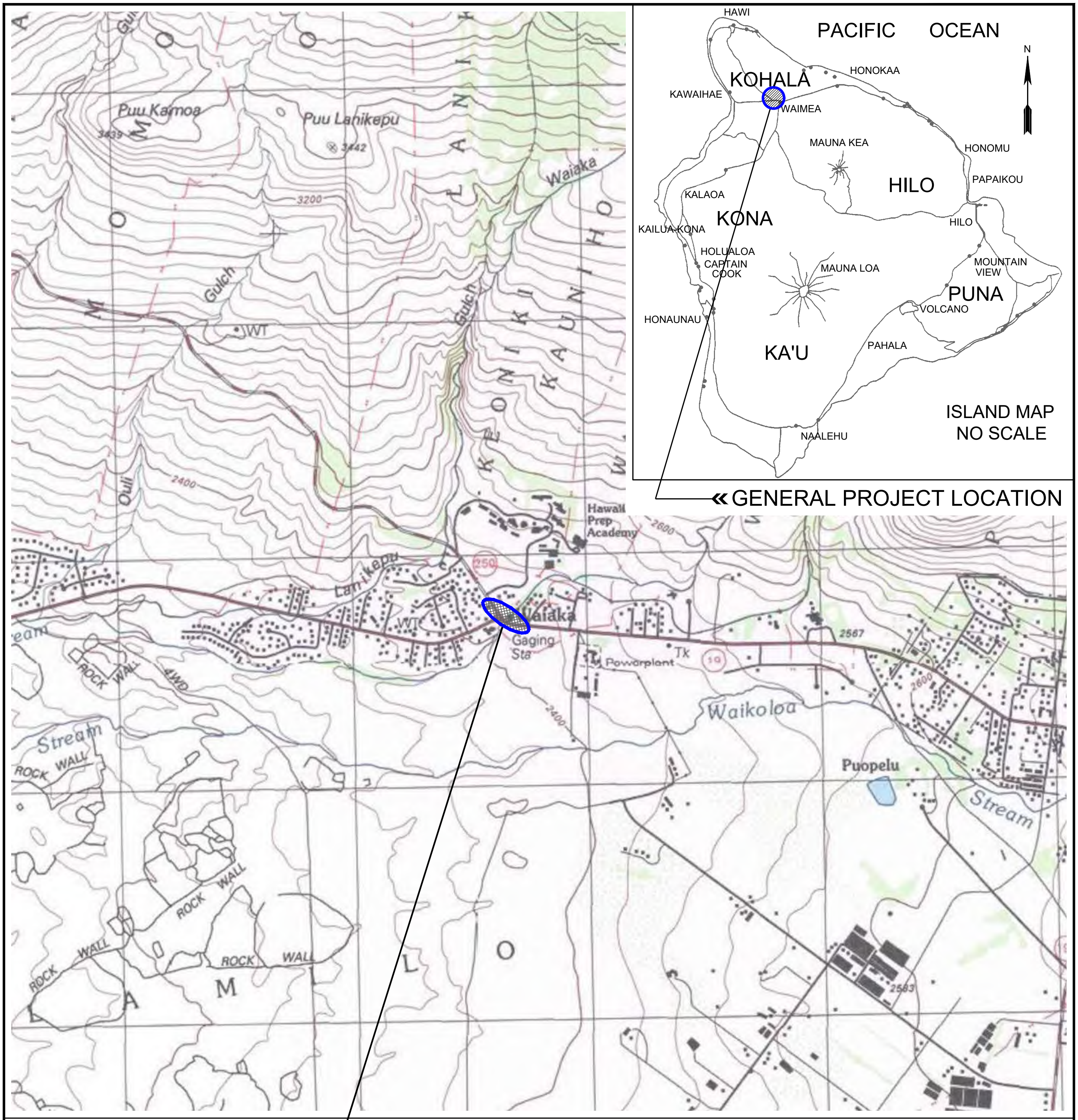
By
Gerald Y. Seki, P.E.
Vice President

By
Glenn Barut, P.E.
Senior Project Engineer

GS:GB:as

h:\8100Series\8190-10.gb4

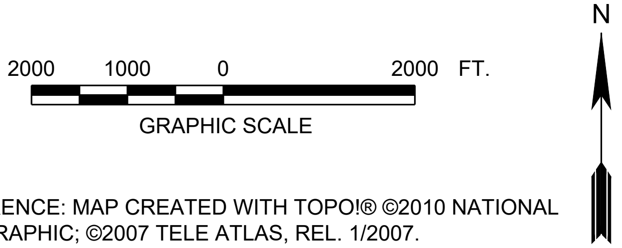
PLATES



PROJECT LOCATION »

PROJECT LOCATION MAP

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

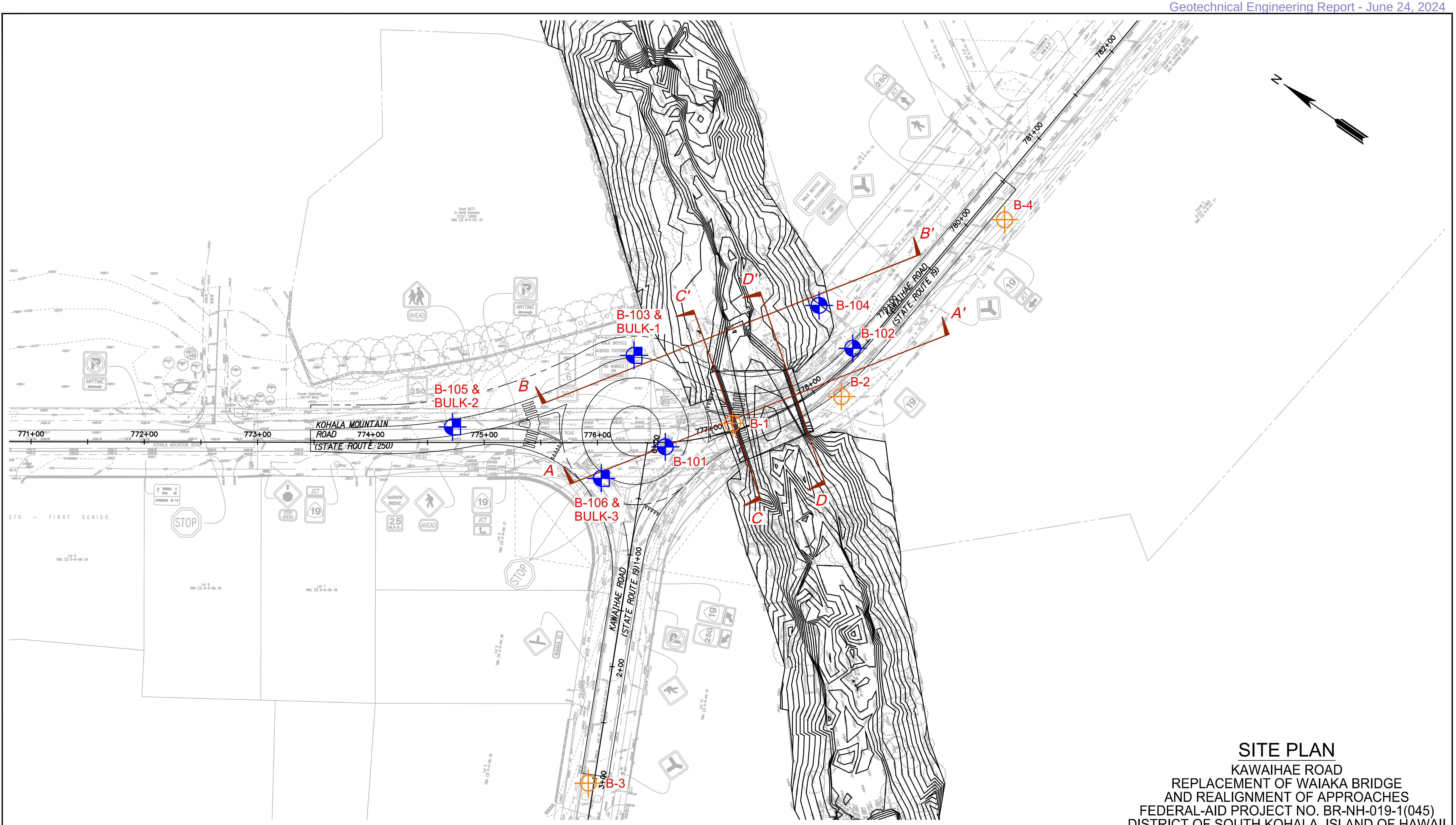


REFERENCE: MAP CREATED WITH TOPO!® ©2010 NATIONAL GEOGRAPHIC; ©2007 TELE ATLAS, REL. 1/2007.

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
SEPTEMBER 2023	HYC	
SCALE	W.O.	
1" = 2,000'	8190-10	1

CAD User: HENRY File Last Updated: September 14, 2023 9:06:52am Plot Date: September 14, 2023 - 9:07:56am
File: B:\Drafting\Working\8190-10_Waiaka_Bridge_Replacement\8190-10PLM.dwg\1
Plotter: DWG To PDF-GEO.pc3 Plotstyle: GEO-No-Dither-RBGC-HEAVY.ctb



SITE PLAN

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

LEGEND:

⊕	APPROXIMATE BORING LOCATION
⊞	APPROXIMATE BULK SAMPLE LOCATION
⊕	APPROXIMATE BORING LOCATION (FROM REPORT BY GEOLABS, INC., W.O. 8190-00, DATED MARCH 8, 2023)
⊔	GENERLIZED GEOLOGIC CROSS-SECTION

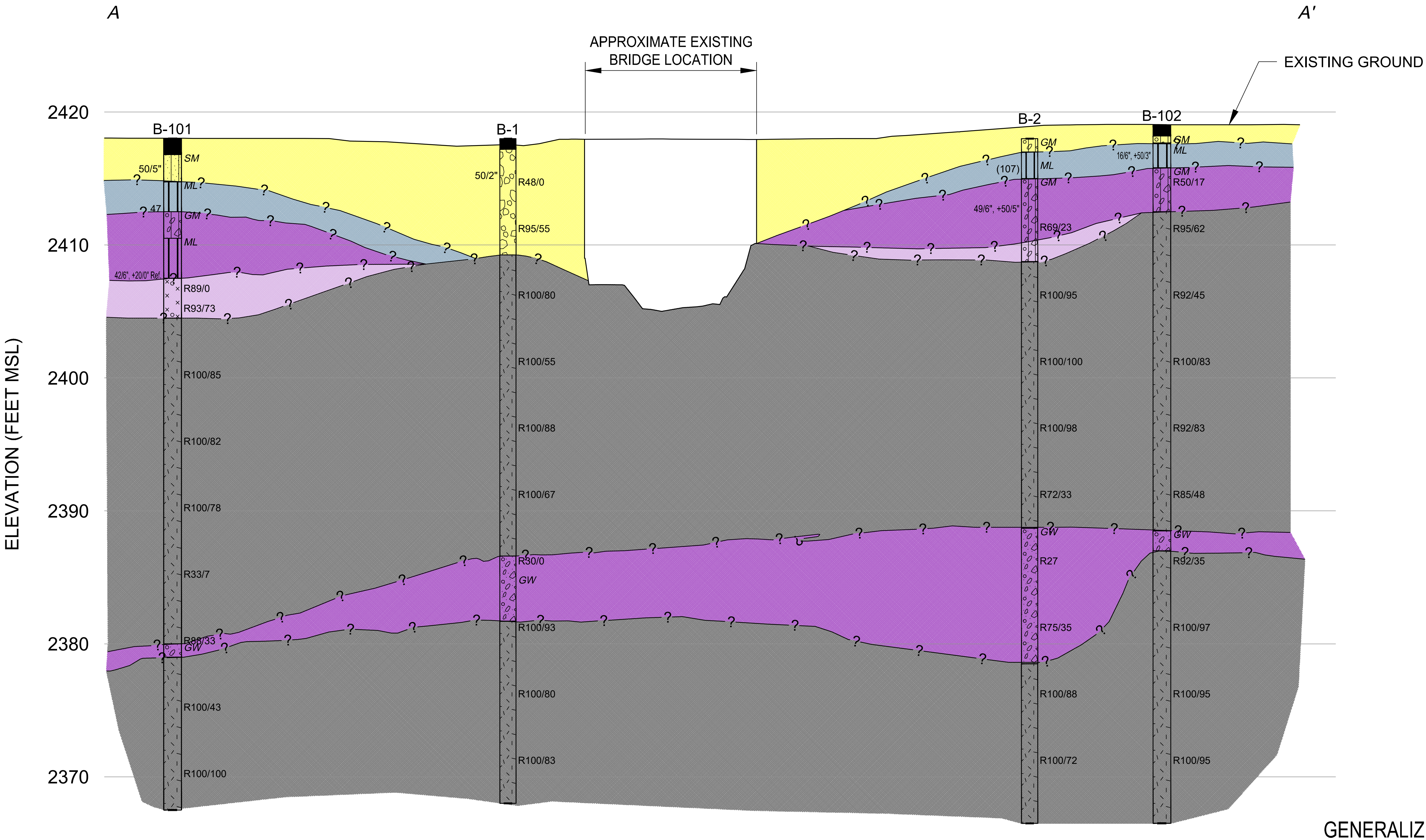
REFERENCE: TOPOGRAPHIC SURVEY MAP TRANSMITTED BY
WSP ON OCTOBER 19, 2022.

0 40 80 160 240 FT.
GRAPHIC SCALE

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
SEPTEMBER 2023	HYC	
SCALE	W.O.	
1" = 80'	8190-10	2

CAD User: HENRY File Last Updated: March 11, 2024 4:00:47pm Plot Date: March 11, 2024 - 4:01:16pm
File: B:\Drafting\Drafting\Working\8190-10_Waiaka_Bridge_Replacement\8190-10SitePlan.dwg\2
Plotter: DWG To PDF-GEO.pc3 Plotstyle: PLOT HP_Half.ctb



LEGEND:

⊻ WATER TABLE MEASURED IN BORING

20 BLOW COUNT REQUIRED FOR 12 INCHES OF PENETRATION OF A 2-INCH O.D. STANDARD PENETRATION SAMPLER

(20) BLOW COUNT REQUIRED FOR 12 INCHES OF PENETRATION OF A 3-INCH O.D. MODIFIED CALIFORNIA SAMPLER

R100/50 REC/RQD VALUES IN PERCENT

NOTE: THE CONDITIONS ILLUSTRATED ARE BASED ON OUR BORINGS AND GEOLOGICAL INTERPRETATIONS. WHILE THESE ARE BELIEVED TO BE GENERALLY CORRECT, THE CONDITIONS MAY VARY LOCALLY FROM THOSE INDICATED.

🟨 FILL

🟦 VOLCANIC ASH

🟪 CLINKER

🟪 WELDED CLINKER

▨ BASALT FORMATION

HORIZONTAL	0	10	20	40	60 FT.
VERTICAL	0	4	8	16	24 FT.

GRAPHIC SCALE

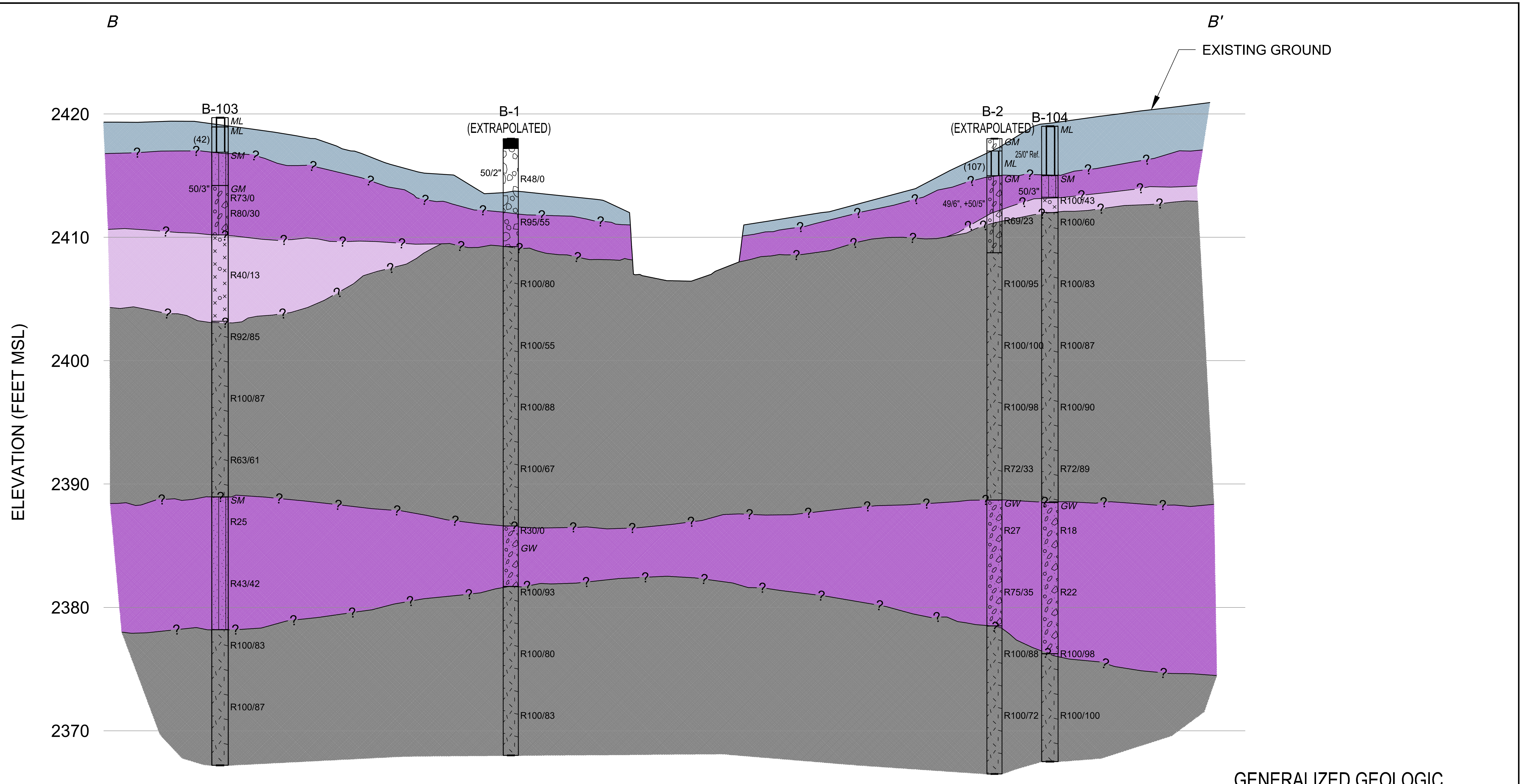
GENERALIZED GEOLOGIC CROSS-SECTION A-A'

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
SEPTEMBER 2023	HYC	
SCALE HORIZ: 1" = 20' VERT: 1" = 8'	W.O. 8190-10	3.1

CAD User: HENRY File Last Updated: March 11, 2024 3:57:50pm Plot Date: March 11, 2024 - 3:58:36pm
File: B:\Drafting\Drafting\Working\8190-10_Waiaka_Bridge_Replacement\8190-10SubsurfaceProfile.dwg\3.1
Plotter: DWG To PDF-GEO.pc3 Plotstyle: GEOLABS-Standard-Half.ctb



LEGEND:

∇	WATER TABLE MEASURED IN BORING
20	BLOW COUNT REQUIRED FOR 12 INCHES OF PENETRATION OF A 2-INCH O.D. STANDARD PENETRATION SAMPLER
(20)	BLOW COUNT REQUIRED FOR 12 INCHES OF PENETRATION OF A 3-INCH O.D. MODIFIED CALIFORNIA SAMPLER
R100/50	REC/RQD VALUES IN PERCENT

NOTE: THE CONDITIONS ILLUSTRATED ARE BASED ON OUR BORINGS AND GEOLOGICAL INTERPRETATIONS. WHILE THESE ARE BELIEVED TO BE GENERALLY CORRECT, THE CONDITIONS MAY VARY LOCALLY FROM THOSE INDICATED.

▨	VOLCANIC ASH
▨	CLINKER
▨	WELDED CLINKER
▨	BASALT FORMATION

HORIZONTAL	0	10	20	40	60 FT.
VERTICAL	0	4	8	16	24 FT.

GRAPHIC SCALE

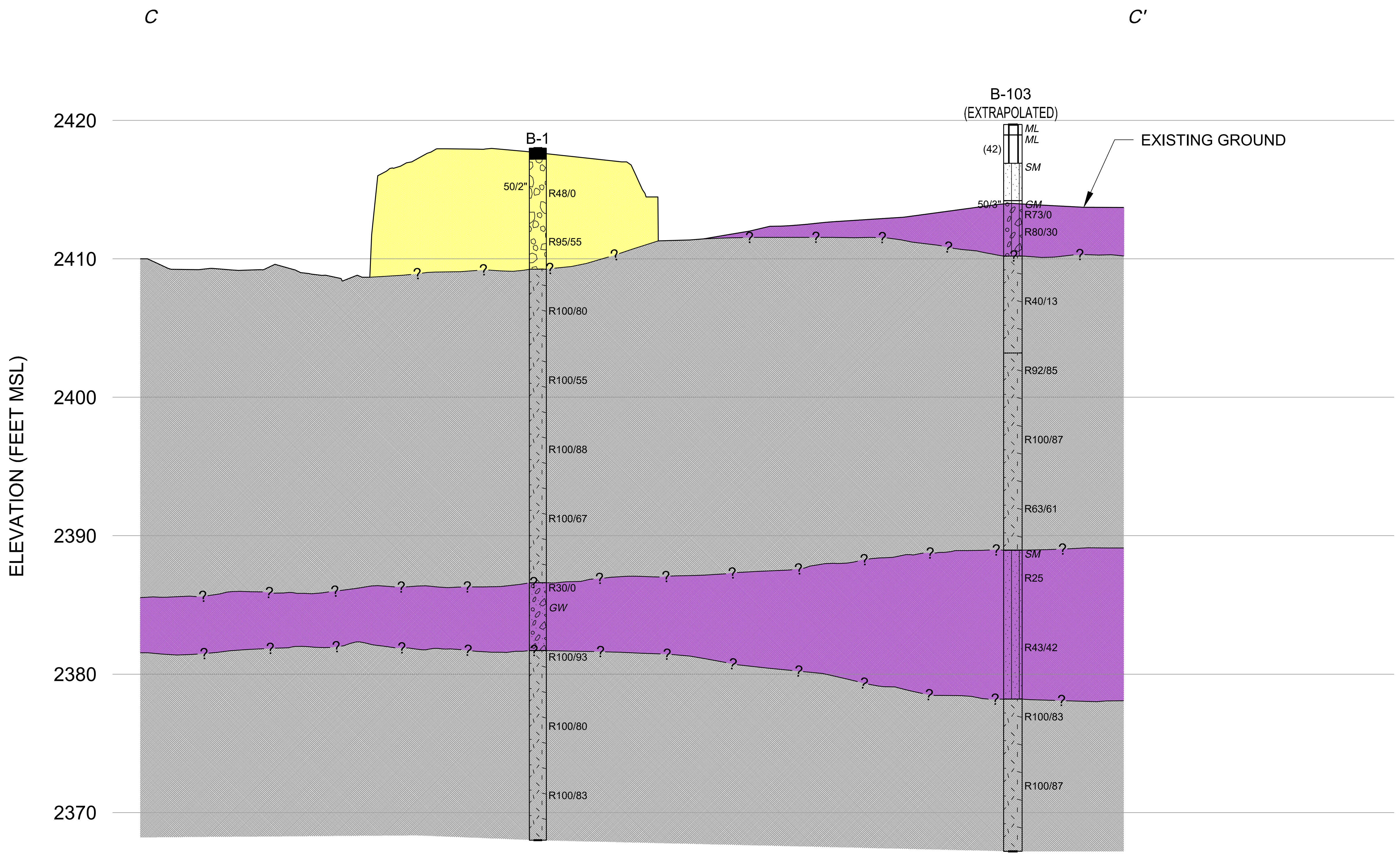
GENERALIZED GEOLOGIC CROSS-SECTION B-B'

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE SEPTEMBER 2023	DRAWN BY HYC	PLATE 3.2
SCALE HORIZ: 1" = 20' VERT: 1" = 8'	W.O. 8190-10	

CAD User: HENRY File Last Updated: March 11, 2024 3:57:50pm Plot Date: March 11, 2024 - 3:58:44pm
File: B:\Drafting\Drafting\Working\8190-10_Waiaka_Bridge_Replacement\8190-10SubsurfaceProfile.dwg\3.2
Plotter: DWG To PDF-GEO.pc3 Plotstyle: GEOLABS-Standard-Half.ctb



LEGEND:

⊻	WATER TABLE MEASURED IN BORING
20	BLOW COUNT REQUIRED FOR 12 INCHES OF PENETRATION OF A 2-INCH O.D. STANDARD PENETRATION SAMPLER
(20)	BLOW COUNT REQUIRED FOR 12 INCHES OF PENETRATION OF A 3-INCH O.D. MODIFIED CALIFORNIA SAMPLER
R100/50	REC/RQD VALUES IN PERCENT

NOTE: THE CONDITIONS ILLUSTRATED ARE BASED ON OUR BORINGS AND GEOLOGICAL INTERPRETATIONS. WHILE THESE ARE BELIEVED TO BE GENERALLY CORRECT, THE CONDITIONS MAY VARY LOCALLY FROM THOSE INDICATED.

🟨	FILL
🟪	CLINKER
▨	BASALT FORMATION

HORIZONTAL	0	10	20	40	60 FT.
VERTICAL	0	4	8	16	24 FT.

GRAPHIC SCALE

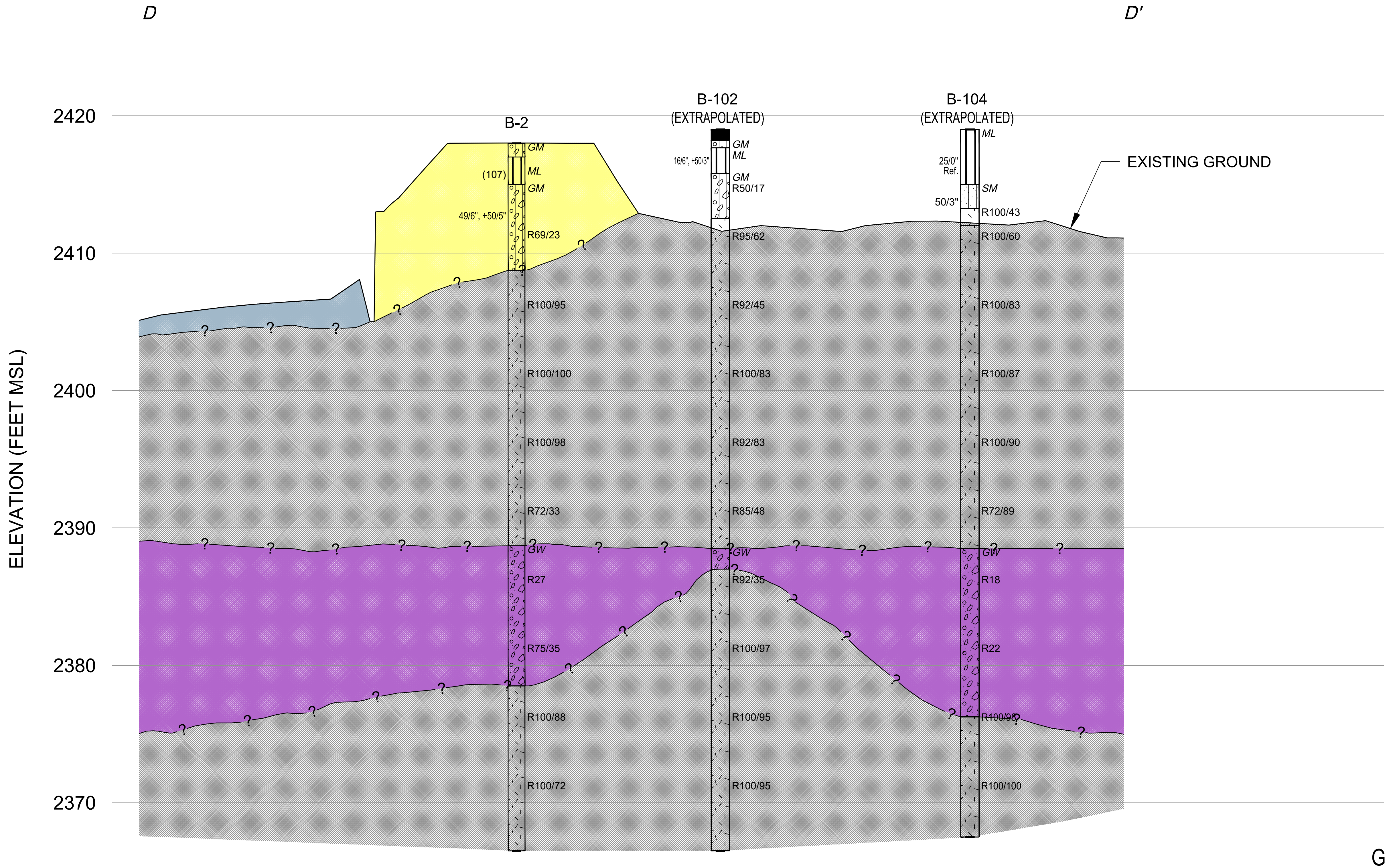
GENERALIZED GEOLOGIC CROSS-SECTION C-C'

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
SEPTEMBER 2023	HYC	3.3
SCALE HORIZ: 1" = 20' VERT: 1" = 8'	W.O. 8190-10	

CAD User: HENRY File Last Updated: March 11, 2024 3:57:50pm Plot Date: March 11, 2024 - 3:58:54pm
File: B:\Drafting\Drafting\Working\8190-10_Waiaka_Bridge_Replacement\8190-10SubsurfaceProfile.dwg\3.3
Plotter: DWG To PDF-GEO.pc3 Plotstyle: GEOLABS-Standard-Half.ctb



GENERALIZED GEOLOGIC CROSS-SECTION D-D'

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

LEGEND:

⊽	WATER TABLE MEASURED IN BORING
20	BLOW COUNT REQUIRED FOR 12 INCHES OF PENETRATION OF A 2-INCH O.D. STANDARD PENETRATION SAMPLER
(20)	BLOW COUNT REQUIRED FOR 12 INCHES OF PENETRATION OF A 3-INCH O.D. MODIFIED CALIFORNIA SAMPLER
R100/50	REC/RQD VALUES IN PERCENT

🟨	FILL
🟦	VOLCANIC ASH
🟪	CLINKER
▨	BASALT FORMATION

NOTE: THE CONDITIONS ILLUSTRATED ARE BASED ON OUR BORINGS AND GEOLOGICAL INTERPRETATIONS. WHILE THESE ARE BELIEVED TO BE GENERALLY CORRECT, THE CONDITIONS MAY VARY LOCALLY FROM THOSE INDICATED.

HORIZONTAL 0 10 20 40 60 FT.
VERTICAL 0 4 8 16 24 FT.
GRAPHIC SCALE

GEOLABS, INC.
Geotechnical Engineering

DATE SEPTEMBER 2023	DRAWN BY HYC	PLATE 3.4
SCALE HORIZ: 1" = 20' VERT: 1" = 8'	W.O. 8190-10	

CAD User: HENRY File Last Updated: March 11, 2024 3:57:50pm Plot Date: March 11, 2024 - 3:59:04pm
File: B:\Drafting\Drafting\Working\8190-10_Waiaka_Bridge_Replacement\8190-10SubsurfaceProfile.dwg\3.4
Plotter: DWG To PDF-GEO.pc3 Plotstyle: GEOLABS-Standard-Half.ctb

APPENDIX A

APPENDIX A

Field Exploration

We explored the subsurface conditions at the project site by drilling and sampling six borings, designated as Boring Nos. 101 through 106, extending to depths of about 10.1 to 52.5 feet below the existing ground/pavement surface. The approximate boring locations are shown on the Site Plan, Plate 2. The borings were drilled using a truck-mounted drill rig with continuous flight augers and coring tools.

Our geologist classified the materials encountered in the borings by visual and textural examination in the field in general accordance with ASTM D2488, Standard Practice for Description and Identification of Soils, and monitored the drilling operations on a near-continuous (full-time) basis. These classifications were further reviewed visually and by testing in the laboratory. Soils were classified in general accordance with ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), as shown on the Soil Log Legend, Plate A-0.1. Deviations made to the soil classification in accordance with ASTM D2487 are described on the Soil Classification Log Key, Plate A-0.2. Rock cores were described in general accordance with the Rock Description System, as shown on the Rock Log Legend, Plate A-0.3. The Rock Description System is based on the publication “Suggested Methods for the Quantitative Description of Discontinuities in Rock Masses” by the International Society for Rock Mechanics (March 1977). Graphic representations of the materials encountered are presented on the Logs of Borings, Plates A-1.1 through A-6.

Relatively “undisturbed” soil samples were obtained in general accordance with ASTM D3550, Ring-Lined Barrel Sampling of Soils, by driving a 3-inch OD Modified California sampler with a 140-pound hammer falling 30 inches. In addition, some samples were obtained from the drilled borings in general accordance with ASTM D1586, Penetration Test and Split-Barrel Sampling of Soils, by driving a 2-inch OD standard penetration sampler using the same hammer and drop. The blow counts needed to drive the sampler the second and third 6 inches of an 18-inch drive are shown as the “Penetration Resistance” on the Logs of Borings at the appropriate sample depths. The penetration resistance shown on the Logs of Borings indicates the number of blows required for the specific sampler type used. The blow counts may need to be factored in to obtain the Standard Penetration Test (SPT) blow counts.

Core samples of the rock materials encountered at the project site were obtained by using diamond core drilling techniques in general accordance with ASTM D2113, Diamond Core Drilling for Site Investigation. Core drilling is a rotary drilling method that uses a hollow bit to cut into the rock formation. The rock material left in the hollow core of the bit is mechanically recovered for examination and description.

Recovery (REC) is used as a subjective guide to the interpretation of the relative quality of rock masses. Recovery is defined as the actual length of material recovered from a coring attempt versus the length of the core attempt. For example, if 3.7 feet of material is recovered from a 5.0-foot core run, the recovery would be 74 percent and would be shown on the Logs of Borings as REC = 74%.

The Rock Quality Designation (RQD) is also a subjective guide to the relative quality of rock masses. RQD is defined as the percentage of the core run in rock that is sound material in excess of 4 inches in length without discontinuities, discounting drilling induced fractures or breaks. If 2.5 feet of sound material is recovered from a 5.0-foot core run in rock, the RQD would be 50 percent and would be shown on the Logs of Borings as RQD = 50%. Generally, the following is used to describe the relative quality of the rock, based on the "Practical Handbook of Physical Properties of Rocks and Minerals."

Rock Quality	**RQD** (%)
Very Poor	0 – 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 – 100

The rippability of a rock mass is a function of the relative hardness of the rock, its relative quality, brittleness, and fissile characteristics. A dense basalt with a high RQD value would be very difficult to rip and would probably require more arduous methods of excavation.

GEOLABS, INC.

Geotechnical Engineering

Soil Log Legend

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISIONS			USCS		TYPICAL DESCRIPTIONS
COARSE-GRAINED SOILS MORE THAN 50% OF MATERIAL RETAINED ON NO. 200 SIEVE	GRAVELS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS LESS THAN 5% FINES	▨	**GW**	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			▨	**GP**	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES MORE THAN 12% FINES	▨	**GM**	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			▨	**GC**	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS 50% OR MORE OF COARSE FRACTION PASSING THROUGH NO. 4 SIEVE	CLEAN SANDS LESS THAN 5% FINES	▨	**SW**	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			▨	**SP**	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES MORE THAN 12% FINES	▨	**SM**	SILTY SANDS, SAND-SILT MIXTURES
			▨	**SC**	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE-GRAINED SOILS 50% OR MORE OF MATERIAL PASSING THROUGH NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	▨	**ML**	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			▨	**CL**	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			▨	**OL**	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT 50 OR MORE	▨	**MH**	INORGANIC SILT, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			▨	**CH**	INORGANIC CLAYS OF HIGH PLASTICITY
			▨	**OH**	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			▨	**PT**	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

LEGEND

◩	(2-INCH) O.D. STANDARD PENETRATION TEST
⧗	(3-INCH) O.D. MODIFIED CALIFORNIA SAMPLE
S	SHELBY TUBE SAMPLE
G	GRAB SAMPLE
▮	CORE SAMPLE
▽	WATER LEVEL OBSERVED IN BORING AT TIME OF DRILLING
▼	WATER LEVEL OBSERVED IN BORING AFTER DRILLING
▼	WATER LEVEL OBSERVED IN BORING OVERNIGHT

LL	LIQUID LIMIT (NP=NON-PLASTIC)
PI	PLASTICITY INDEX (NP=NON-PLASTIC)
TV	TORVANE SHEAR (tsf)
UC	UNCONFINED COMPRESSION OR UNIAXIAL COMPRESSIVE STRENGTH
TXUU	UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (ksf)

LOG LEGEND FOR SOIL 8190-10.GPJ GEOLABS.GDT 9/13/23

GEOLABS, INC.

Geotechnical Engineering

Soil Classification Log Key

(with deviations from ASTM D2488)

GEOLABS, INC. CLASSIFICATION*

GRANULAR SOIL (- #200 <50%)

- **PRIMARY** constituents are composed of the largest percent of the soil mass. Primary constituents are capitalized and bold (i.e., **GRAVEL, SAND**)
- **SECONDARY** constituents are composed of a percentage less than the primary constituent. If the soil mass consists of 12 percent or more fines content, a cohesive constituent is used (**SILTY** or **CLAYEY**); otherwise, a granular constituent is used (**GRAVELLY** or **SANDY**) provided that the secondary constituent consists of 20 percent or more of the soil mass. Secondary constituents are capitalized and bold (i.e., **SANDY** GRAVEL, **CLAYEY** SAND) and precede the primary constituent.
- **accessory descriptions** compose of the following:
  with some: >12%
  with a little: 5 - 12%
  with traces of: <5%
  accessory descriptions are lower cased and follow the Primary and Secondary Constituents
  (i.e., SILTY GRAVEL **with a little sand**)

COHESIVE SOIL (- #200 ≥50%)

- **PRIMARY** constituents are based on plasticity. Primary constituents are capitalized and bold (i.e., **CLAY, SILT**)
- **SECONDARY** constituents are composed of a percentage less than the primary constituent, but more than 20 percent of the soil mass. Secondary constituents are capitalized and bold (i.e., **SANDY** CLAY, **SILTY** CLAY, **CLAYEY** SILT) and precede the primary constituent.
- **accessory descriptions** compose of the following:
  with some: >12%
  with a little: 5 - 12%
  with traces of: <5%
  accessory descriptions are lower cased and follow the Primary and Secondary Constituents
  (i.e., SILTY CLAY **with some sand**)

EXAMPLE: Soil Containing 60% Gravel, 25% Sand, 15% Fines. Described as: **SILTY GRAVEL** with some sand

RELATIVE DENSITY / CONSISTENCY

Granular Soils			Cohesive Soils			
N-Value (Blows/Foot)		Relative Density	N-Value (Blows/Foot)		PP Readings (tsf)	Consistency
SPT	MCS		SPT	MCS		
0 - 4	0 - 7	Very Loose	0 - 2	0 - 4		Very Soft
4 - 10	7 - 18	Loose	2 - 4	4 - 7	< 0.5	Soft
10 - 30	18 - 55	Medium Dense	4 - 8	7 - 15	0.5 - 1.0	Medium Stiff
30 - 50	55 - 91	Dense	8 - 15	15 - 27	1.0 - 2.0	Stiff
> 50	> 91	Very Dense	15 - 30	27 - 55	2.0 - 4.0	Very Stiff
			> 30	> 55	> 4.0	Hard

MOISTURE CONTENT DEFINITIONS

Dry: Absence of moisture, dry to the touch

Moist: Damp but no visible water

Wet: Visible free water

GRAIN SIZE DEFINITION

Description	Sieve Number and / or Size
Boulders	> 12 inches (305-mm)
Cobbles	3 to 12 inches (75-mm to 305-mm)
Gravel	3-inch to #4 (75-mm to 4.75-mm)
Coarse Gravel	3-inch to 3/4-inch (75-mm to 19-mm)
Fine Gravel	3/4-inch to #4 (19-mm to 4.75-mm)
Sand	#4 to #200 (4.75-mm to 0.075-mm)
Coarse Sand	#4 to #10 (4.75-mm to 2-mm)
Medium Sand	#10 to #40 (2-mm to 0.425-mm)
Fine Sand	#40 to #200 (0.425-mm to 0.075-mm)

ABBREVIATIONS

WOH:	Weight of Hammer
WOR:	Weight of Drill Rods
SPT:	Standard Penetration Test Split-Spoon Sampler
MCS:	Modified California Sampler
PP:	Pocket Penetrometer

Soil descriptions are based on ASTM D2488-09a, Visual-Manual Procedure, with the above modifications by Geolabs, Inc. to the Unified Soil Classification System (USCS).

Plate

A-0.2

GEOLABS, INC.

Geotechnical Engineering

Rock Log Legend

ROCK DESCRIPTIONS

⁄	**BASALT**	○·	**CONGLOMERATE**
○	**BOULDERS**	▦	**LIMESTONE**
△	**BRECCIA**	⁘	**SANDSTONE**
×○	**CLINKER**	×	**SILTSTONE**
⬠	**COBBLES**	▩	**TUFF**
☼	**CORAL**		**VOID/CAVITY**

ROCK DESCRIPTION SYSTEM

ROCK FRACTURE CHARACTERISTICS

The following terms describe general fracture spacing of a rock:

Massive:	Greater than 24 inches apart
Slightly Fractured:	12 to 24 inches apart
Moderately Fractured:	6 to 12 inches apart
Closely Fractured:	3 to 6 inches apart
Severely Fractured:	Less than 3 inches apart

DEGREE OF WEATHERING

The following terms describe the chemical weathering of a rock:

Unweathered:	Rock shows no sign of discoloration or loss of strength.
Slightly Weathered:	Slight discoloration inwards from open fractures.
Moderately Weathered:	Discoloration throughout and noticeably weakened though not able to break by hand.
Highly Weathered:	Most minerals decomposed with some corestones present in residual soil mass. Can be broken by hand.
Extremely Weathered:	Saprolite. Mineral residue completely decomposed to soil but fabric and structure preserved.

HARDNESS

The following terms describe the resistance of a rock to indentation or scratching:

Very Hard:	Specimen breaks with difficulty after several "pinging" hammer blows. Example: Dense, fine grain volcanic rock
Hard:	Specimen breaks with some difficulty after several hammer blows. Example: Vesicular, vugular, coarse-grained rock
Medium Hard:	Specimen can be broked by one hammer blow. Cannot be scraped by knife. SPT may penetrate by ~25 blows per inch with bounce. Example: Porous rock such as clinker, cinder, and coral reef
Soft:	Can be indented by one hammer blow. Can be scraped or peeled by knife. SPT can penetrate by ~100 blows per foot. Example: Weathered rock, chalk-like coral reef
Very Soft:	Crumbles under hammer blow. Can be peeled and carved by knife. Can be indented by finger pressure. Example: Saprolite

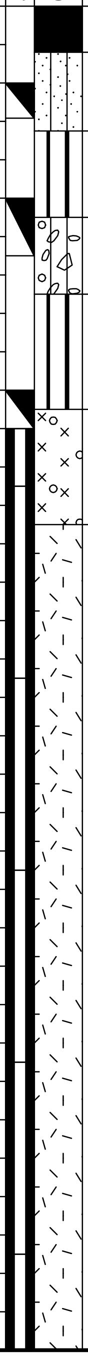
GEOLABS, INC.

Geotechnical Engineering

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Log of Boring
101

Approximate Ground Surface Elevation (feet): 2418 *



Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											14-inch **ASPHALTIC CONCRETE**
	11				50/5"					SM	Gray and brown **SILTY SAND (BASALTIC)** with some gravel and a little cobbles, dense, moist (fill)
Sieve - #200 = 20.3%	23				47		5			ML	Brown **CLAYEY SILT**, stiff to very stiff, moist (volcanic ash)
										GM	Gray and brown **SILTY GRAVEL (BASALTIC)** with some sand, dense, moist (clinker)
	41				42/6" +20/0" Ref.		10			ML	Brown and gray **CLAYEY SILT** with some gravel (basaltic), stiff to very stiff, moist (weathered clinker)
			89 93	0 73							Gray and brown cemented **CLINKER**, closely fractured, slightly weathered, medium hard to hard (welded clinker)
UC= 10820 psi							15				Gray vugular **BASALT**, moderately fractured, unweathered to slightly weathered, very hard (a'a basalt)
UC= 14130 psi											
			100	85							
UC= 12580 psi							20				grades to dense
			100	82			25				
			100	78			30				
			33	7			35				

Date Started:	August 7, 2023	Water Level: ▼	Not Encountered
Date Completed:	August 9, 2023		
Logged By:	S. Latronic	Drill Rig:	MOBILE B-53.1 *(Energy Transfer Ratio = 42.9%)*
Total Depth:	50.5 feet	Drilling Method:	4" Solid-Stem Auger & HQ Coring
Work Order:	8190-10	Driving Energy:	140 lb. wt., 30 in. drop

GEOLABS, INC.

Geotechnical Engineering

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Log of Boring

101

(Continued from previous plate)

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
			88	33						GW	Reddish gray **SANDY GRAVEL (BASALTIC)** with a little cobbles, medium dense to dense, moist (clinker)
							40				Gray vugular **BASALT**, moderately to closely fractured, unweathered to slightly weathered, hard (a'a basalt)
			100	43							
							45				
			100	100							grades to very hard, and massive
							50				
											Boring terminated at 50.5 feet * Elevations estimated from Topographic Survey Map transmitted by WSP on October 19, 2022.
							55				
							60				
							65				
							70				

Date Started: August 7, 2023
Date Completed: August 9, 2023
Logged By: S. Latronic
Total Depth: 50.5 feet
Work Order: 8190-10

Water Level: ▼ Not Encountered
Drill Rig: MOBILE B-53.1 *(Energy Transfer Ratio = 42.9%)*
Drilling Method: 4" Solid-Stem Auger & HQ Coring
Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 1.2

GEOLABS, INC.

Geotechnical Engineering

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Log of Boring

102

Approximate Ground Surface Elevation (feet): 2419 *

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											10-inch **ASPHALTIC CONCRETE**
										GM	Gray with some brown **SILTY GRAVEL (BASALTIC)**, dense, moist (fill)
LL=38 PI=1	34				16/6" +50/3"					ML	Brown **CLAYEY SILT**, stiff to very stiff, moist (volcanic ash)
			50	17			5			GM	Brownish gray **SILTY GRAVEL (BASALTIC)** with a little cobbles, dense, moist (clinker)
			95	62							Brownish gray to gray vugular **BASALT**, moderately fractured, unweathered to slightly weathered, hard to very hard (a'a basalt)
UC= 7630 psi							10				
			92	45							
UC= 5450 psi							15				
			100	83							
							20				
			92	83							grades to massive, dense
							25				
			85	48							
							30			GW	Gray with some brown **SANDY GRAVEL (BASALTIC)** with some cobbles, medium dense to dense, moist (clinker)
			92	35							
							35				

Date Started:	August 10, 2023	Water Level: ▼	Not Encountered
Date Completed:	August 10, 2023		
Logged By:	S. Latronic	Drill Rig:	MOBILE B-53.1 *(Energy Transfer Ratio = 42.9%)*
Total Depth:	52.5 feet	Drilling Method:	4" Solid-Stem Auger & HQ Coring
Work Order:	8190-10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 2.1

GEOLABS, INC. Geotechnical Engineering	KAWAIHAE ROAD REPLACEMENT OF WAIAKA BRIDGE AND REALIGNMENT OF APPROACHES FEDERAL-AID PROJECT NO. BR-NH-019-1(045) DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII	**Log of Boring** 102

Laboratory			Field								(Continued from previous plate)
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											Reddish brown to gray vugular **BASALT**, slightly to moderately fractured, unweathered to slightly weathered, hard (a'a basalt)
			100	97							
							40				
			100	95							grades to massive, very hard
							45				
			100	95							
							50				
											Boring terminated at 52.5 feet
							55				
							60				
							65				
							70				

Date Started:	August 10, 2023	Water Level: ▼	Not Encountered	Plate A - 2.2
Date Completed:	August 10, 2023			
Logged By:	S. Latronic	Drill Rig:	MOBILE B-53.1 *(Energy Transfer Ratio = 42.9%)*	
Total Depth:	52.5 feet	Drilling Method:	4" Solid-Stem Auger & HQ Coring	
Work Order:	8190-10	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC.

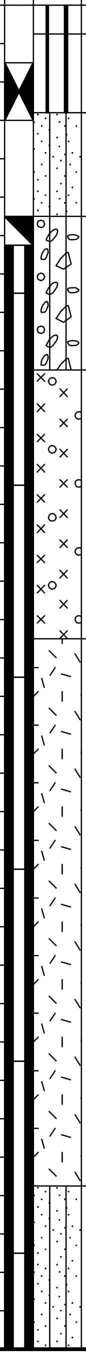
Geotechnical Engineering

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Log of Boring

103

Approximate Ground Surface Elevation (feet): 2419.7 *



Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
								ML	Brown with some gray **CLAYEY SILT** with a little gravel (basaltic), very stiff, moist (fill)
Direct Shear	24	61			42			ML	Orangish brown **CLAYEY SILT**, stiff, moist (volcanic ash)
							5	SM	Gray and brown **SILTY SAND (BASALTIC)** with some gravel, medium dense to dense, moist (weathered clinker)
Sieve - #200 = 29.8%	19		73	0	50/3"			GM	Gray and brown **SILTY GRAVEL (BASALTIC)** with some sand, dense, moist (clinker)
			80	30					
UC= 800 psi							10		Gray and brown cemented **CLINKER**, moderately to closely fractured, slightly weathered, medium hard to hard (welded clinker)
			40	13					
							15		
UC= 7680 psi			92	85					Gray vugular **BASALT**, slightly to moderately fractured, unweathered to slightly weathered, very hard (a'a basalt)
							20		grades to dense
			100	87					
							25		
			63	61					
							30	SM	Reddish brown and gray **SILTY SAND (BASALTIC)** with some gravel and a little cobbles, medium dense to dense, moist (clinker)
			25						
							35		

Date Started:	August 11, 2023	Water Level: ▼	Not Encountered
Date Completed:	August 14, 2023		
Logged By:	S. Latronic	Drill Rig:	MOBILE B-53.1 *(Energy Transfer Ratio = 42.9%)*
Total Depth:	52.5 feet	Drilling Method:	4" Solid-Stem Auger & HQ Coring
Work Order:	8190-10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 3.1

GEOLABS, INC.

Geotechnical Engineering

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Log of Boring

103

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	(Continued from previous plate) Description
										SM	
			43	42							
							40				
			100	83							Gray vugular **BASALT**, slightly to moderately fractured, unweathered to slightly weathered, hard to very hard (a'a basalt)
							45				
			100	87							
							50				
											Boring terminated at 52.5 feet
							55				
							60				
							65				
							70				

Date Started:	August 11, 2023	Water Level: ▼	Not Encountered
Date Completed:	August 14, 2023		
Logged By:	S. Latronic	Drill Rig:	MOBILE B-53.1 *(Energy Transfer Ratio = 42.9%)*
Total Depth:	52.5 feet	Drilling Method:	4" Solid-Stem Auger & HQ Coring
Work Order:	8190-10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 3.2

GEOLABS, INC.

Geotechnical Engineering

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Log of Boring

104

Approximate Ground Surface Elevation (feet): 2419 *

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
										ML	Brown **SANDY SILT** with a little gravel (basaltic), stiff to very stiff, moist (volcanic ash)
Sieve - #200 = 66.4%	37				25/0" Ref.						
										SM	Brown **SILTY SAND** with some cobbles and gravel, dense, moist
Sieve - #200 = 33.2%	21				50/3"		5				
			100	43							Reddish gray cemented **CLINKER**, moderately fractured, slightly weathered, medium hard to hard (welded clinker)
			100	60							Gray vugular **BASALT**, slightly to moderately fractured, unweathered to slightly weathered, hard to very hard (a'a basalt)
							10				
UC= 6340 psi											
			100	83							
UC= 5270 psi											
							15				
			100	87							
UC= 11810 psi											
							20				
			100	90							
							25				
			72	89							
							30				
										GW	Brownish gray **SANDY GRAVEL (BASALTIC)** with a little cobbles, medium dense to dense, moist (clinker)
			18								
							35				

Date Started: August 10, 2023
Date Completed: August 11, 2023
Logged By: S. Latronic
Total Depth: 51.5 feet
Work Order: 8190-10

Water Level: ▼ Not Encountered
Drill Rig: MOBILE B-53.1 *(Energy Transfer Ratio = 42.9%)*
Drilling Method: 4" Solid-Stem Auger & HQ Coring
Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 4.1

GEOLABS, INC.

Geotechnical Engineering

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Log of Boring

104

(Continued from previous plate)

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
										GW	
			22								
							40				
			100	98							Gray dense **BASALT**, slightly to massive fractured, unweathered, very hard (a'a basalt)
							45				
			100	100							
							50				grades to vugular
											Boring terminated at 51.5 feet
							55				
							60				
							65				
							70				

Date Started: August 10, 2023
Date Completed: August 11, 2023
Logged By: S. Latronic
Total Depth: 51.5 feet
Work Order: 8190-10

Water Level: ▼ Not Encountered
Drill Rig: MOBILE B-53.1 *(Energy Transfer Ratio = 42.9%)*
Drilling Method: 4" Solid-Stem Auger & HQ Coring
Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 4.2

GEOLABS, INC.

Geotechnical Engineering

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Log of Boring
105

Approximate Ground Surface Elevation (feet): 2421.9 *

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											9-inch **ASPHALTIC CONCRETE**
										GM	Brownish gray **SILTY GRAVEL (BASALTIC)**, dense, dry to moist (fill)
Direct Shear	31 40	72			35 49					ML	Orangish brown **CLAYEY SILT** with traces of gravel (basaltic), very stiff, moist (volcanic ash)
Sieve - #200 = 9.0%	12	110			43/6" +50/5"		5			GW-GM	Gray and brown **SANDY GRAVEL (BASALTIC)** with a little silt, dense, moist (weathered clinker)
											Gray **GRAVELLY COBBLES (BASALTIC)** with some sand and silt, very dense, dry (clinker)
					25/1"		10				Boring terminated at 10.1 feet
							15				
							20				
							25				
							30				
							35				

Date Started:	August 7, 2023	Water Level: ▼	Not Encountered
Date Completed:	August 7, 2023		
Logged By:	S. Latronic	Drill Rig:	MOBILE B-53.1 *(Energy Transfer Ratio = 42.9%)*
Total Depth:	10.1 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	8190-10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 5

GEOLABS, INC.

Geotechnical Engineering

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Log of Boring

106

Approximate Ground Surface Elevation (feet): 2417.4 *

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											5-inch **ASPHALTIC CONCRETE**
										GM	Brownish gray **SILTY GRAVEL (BASALTIC)**, dense, dry to moist (fill)
LL=67 PI=23 Sieve - #200 = 36.9%	46 35	64			27 39					ML	Brown **CLAYEY SILT** with traces of gravel (basaltic), stiff to very stiff, moist (volcanic ash)
							5			GM	Brownish gray **SILTY GRAVEL** with some sand, medium dense to dense, moist (weathered clinker)
Sieve - #200 = 32.0%	28				47					SM	Brownish gray **SILTY SAND (BASALTIC)** with some gravel, dense, moist (weathered clinker)
					50/3"		10				Brownish gray **GRAVELLY COBBLES (BASALTIC)** with some sand, very dense, moist (clinker)
							15 20 25 30 35				Boring terminated at 10.25 feet

Date Started:	August 7, 2023
Date Completed:	August 7, 2023
Logged By:	S. Latronic
Total Depth:	10.25 feet
Work Order:	8190-10

Water Level: ▼	Not Encountered
Drill Rig:	MOBILE B-53.1 *(Energy Transfer Ratio = 42.9%)*
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 6

APPENDIX B

APPENDIX B

Laboratory Tests

Moisture Content (ASTM D2216) and Unit Weight (ASTM D2937) determinations were performed on selected samples as an aid in the classification and evaluation of soil properties. The test results are presented on the Logs of Borings at the appropriate sample depths.

Two Atterberg Limits tests (ASTM D4318) were performed on selected soil samples to evaluate the liquid and plastic limits to aid in soil classifications. The test results are summarized on the Logs of Borings at the appropriate sample depths. A graphic presentation of the test results is provided on Plate B-1.

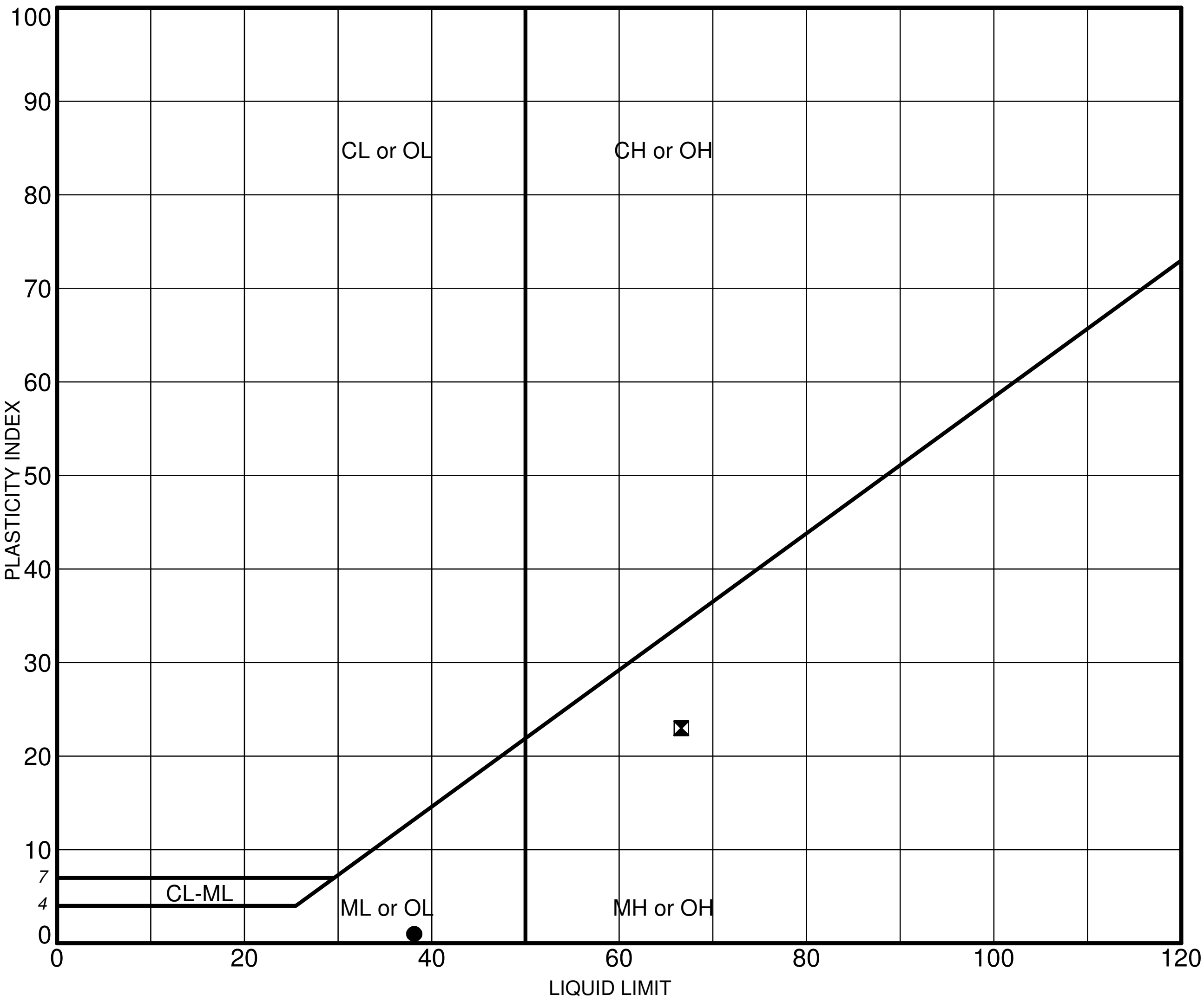
Seven Sieve Analysis tests (ASTM D6913) were performed on selected soil samples to evaluate the gradation characteristics of the soils and to aid in soil classification. Graphic presentations of the grain size distributions are provided on Plates B-2 and B-3.

Ten Uniaxial Compressive Strength tests (ASTM D7012, Method C) were performed on selected intact core runs to evaluate the unconfined compressive strength of the basalt formation encountered. The test results are presented on Plate B-4.

Three laboratory California Bearing Ratio tests (ASTM D1883) were performed on bulk samples of the near-surface soils to evaluate the pavement support characteristics and swell potential of the soils. The test results are presented on Plates B-5 through B-7.

Corrosivity tests, including three sets of pH (ASTM G51), Resistivity (ASTM G57), Chloride Content (EPA 300.0), and Sulfate Content (EPA 300.0), were performed by Geolabs, Inc. and Eurofins TestAmerica Laboratories, Inc. on selected soil samples obtained from our field exploration. The test results are summarized on Plate B-8.

Three laboratory Resistance (R) value tests (ASTM D2844) were performed by Ninyo & Moore on bulk samples of the near-surface soils to evaluate the pavement support characteristics of the soils. The test results are presented on Plates B-9 through B-11.



	Sample	Depth (ft)	LL	PL	PI	Description
●	B-102	2.0-3.3	38	37	1	Brown clayey silt (ML)
☒	B-106	1.5-3.0	67	44	23	Brown clayey silt (MH) with traces of gravel

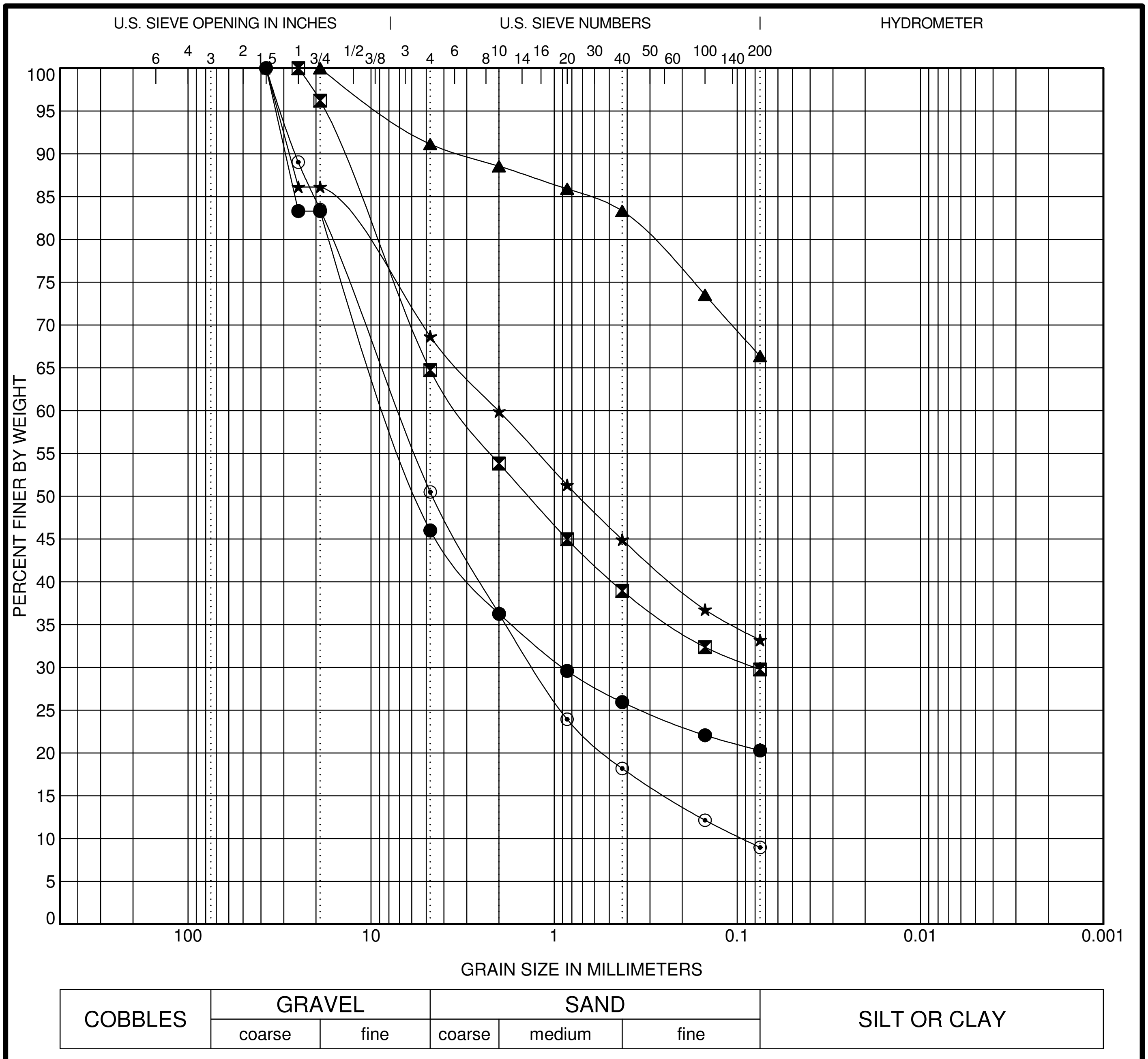
NP = NON-PLASTIC

GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8190-10

ATTERBERG LIMITS TEST RESULTS - ASTM D4318

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Plate
B - 1



	Sample	Depth (ft)	Description	LL	PL	PI	Cc	Cu
●	B-101	5.0-6.5	Gray and brown silty gravel (GM) with some sand					
⊠	B-103	5.5-6.3	Gray and brown silty gravel (GM) with some sand					
▲	B-104	2.0-2.5	Brown sandy silt (ML) with a little gravel					
★	B-104	5.0-5.8	Brown silty sand (SM) with some gravel					
⊙	B-105	5.5-6.9	Gray and brown sandy gravel (GW-GM) with a little silt				2.5	75.3

	Sample	Depth (ft)	D100 (mm)	D60 (mm)	D30 (mm)	D10 (mm)	%Gravel	%Sand	%Fine
●	B-101	5.0-6.5	37.5	7.993	0.897		54.0	25.7	20.3
⊠	B-103	5.5-6.3	25	3.268	0.08		35.3	35.0	29.8
▲	B-104	2.0-2.5	19				8.9	24.8	66.4
★	B-104	5.0-5.8	37.5	2.021			31.3	35.5	33.2
⊙	B-105	5.5-6.9	37.5	7.083	1.296	0.094	49.5	41.5	9.0

G_GRAIN_SIZE_MOD 8190-10.GPJ GEOLABS.GDT 9/18/23

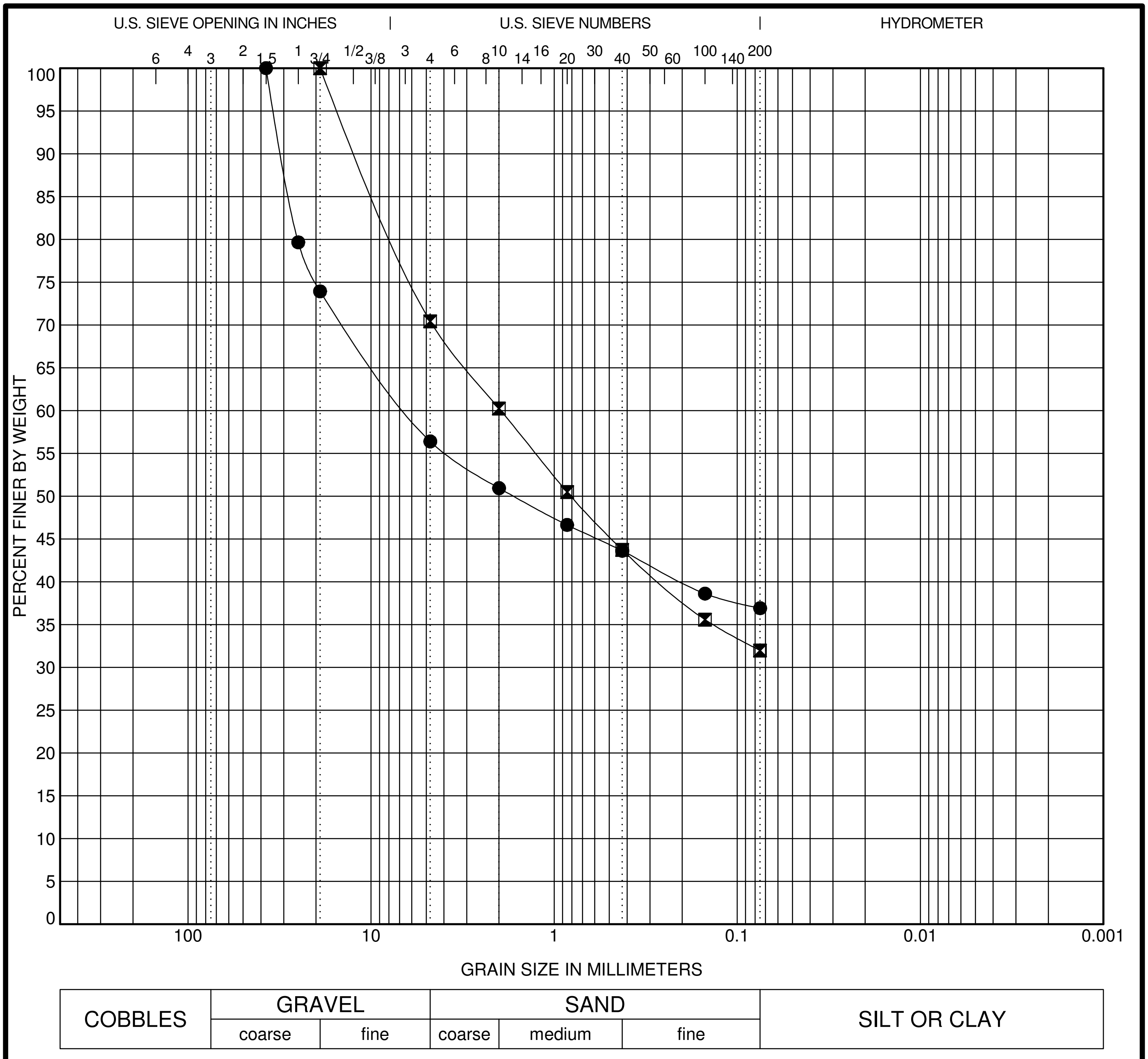
GEOLABS, INC.
GEOTECHNICAL ENGINEERING

W.O. 8190-10

GRAIN SIZE DISTRIBUTION - ASTM D6913

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Plate
B - 2



	Sample	Depth (ft)	Description	LL	PL	PI	Cc	Cu
●	B-106	3.0-4.5	Brownish gray silty gravel (GM) with some sand					
☒	B-106	5.5-7.5	Brownish gray silty sand (SM) with some gravel					

	Sample	Depth (ft)	D100 (mm)	D60 (mm)	D30 (mm)	D10 (mm)	%Gravel	%Sand	%Fine
●	B-106	3.0-4.5	37.5	6.319			43.6	19.5	36.9
☒	B-106	5.5-7.5	19	1.959			29.6	38.5	32.0

G_GRAIN_SIZE_MOD 8190-10.GPJ GEOLABS.GDT 9/18/23

GEOLABS, INC.
GEOTECHNICAL ENGINEERING

W.O. 8190-10

GRAIN SIZE DISTRIBUTION - ASTM D6913

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Plate
B - 3

Location	Depth	Length	Diameter	Length/ Diameter Ratio	Density	Load	Compressive Strength
	(feet)	(inches)	(inches)		(pcf)	(lbs)	(psi)
B-101	14 - 15	5.480	2.391	2.29	164.1	48,600	10,820
B-101	16 - 17	5.466	2.390	2.29	168.4	63,410	14,130
B-101	19.5 - 20.5	5.465	2.392	2.28	175.9	56,530	12,580
B-102	9.5 - 10.5	5.526	2.393	2.31	165.2	34,300	7,630
B-102	14 - 15	5.467	2.394	2.28	153.6	24,520	5,450
B-103	10 - 11	5.483	2.392	2.29	129.7	3,590	800
B-103	18 - 19	5.464	2.392	2.28	169.1	34,500	7,680
B-104	10.5 - 11.5	5.482	2.400	2.28	155.8	28,680	6,340
B-104	13.5 - 14.5	5.499	2.396	2.30	159.2	23,770	5,270
B-104	19 - 20	5.439	2.399	2.27	170.6	53,380	11,810

ASTM D7012 (METHOD C)

Note: Samples were not prepared in accordance with ASTM D4543. Therefore, results reported may differ from results obtained from a test speciment that meets the requirements of Practice D4543

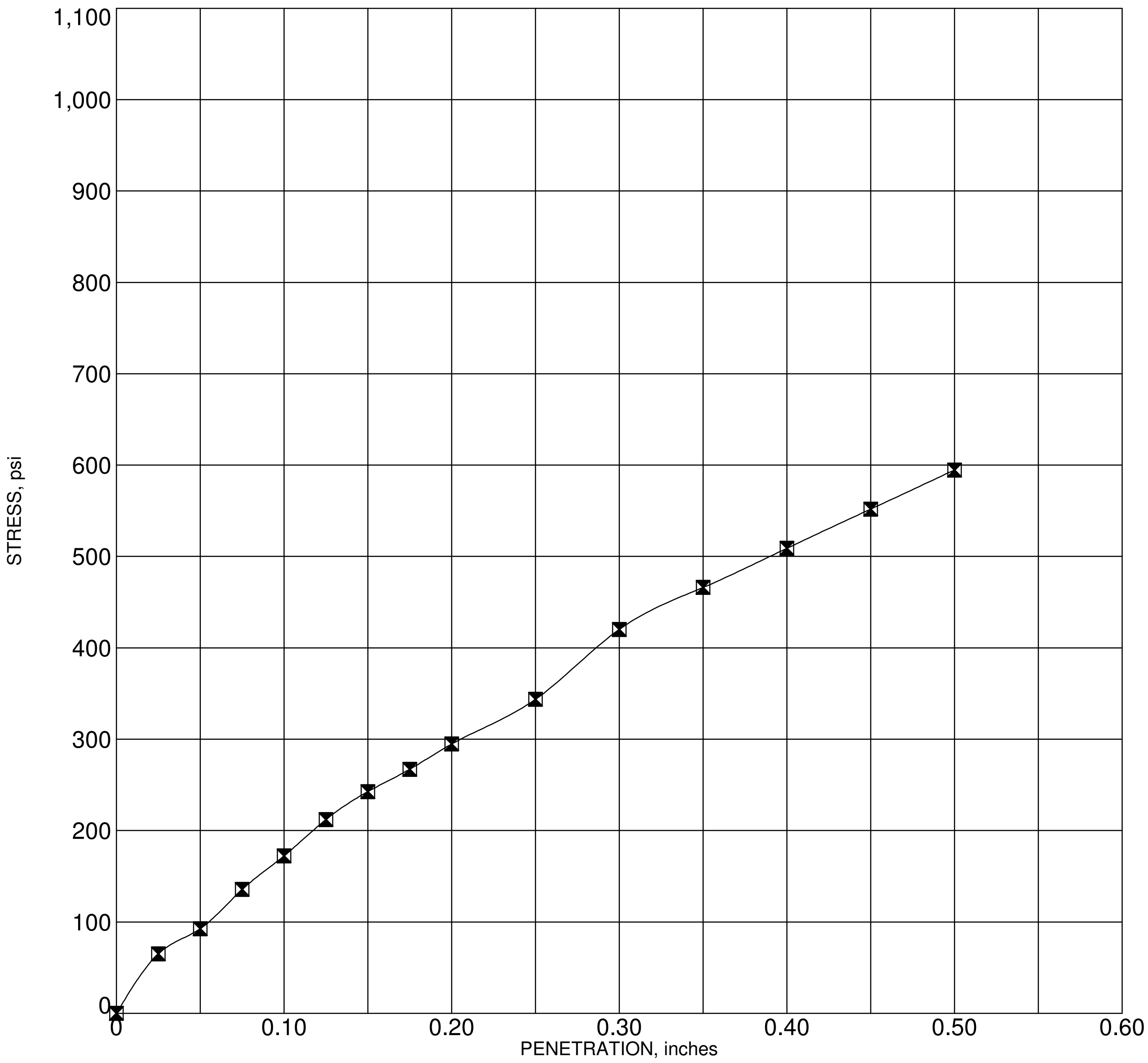
GEOLABS, INC.
GEOTECHNICAL ENGINEERING

W.O. 8190-10

UNIAXIAL COMPRESSIVE STRENGTH TEST

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Plate
B - 4



Corr. CBR @ 0.1"	17.2
Corr. CBR @ 0.2"	19.6
Swell (%)	1.44

Sample: Bulk-1
Depth: 0.0 - 2.0 feet
Description: Brown clayey silt with some sand

Molding Dry Density (pcf)	99.0	Hammer Wt. (lbs)	10
Molding Moisture (%)	20.8	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

GEOLABS, INC.
GEOTECHNICAL ENGINEERING

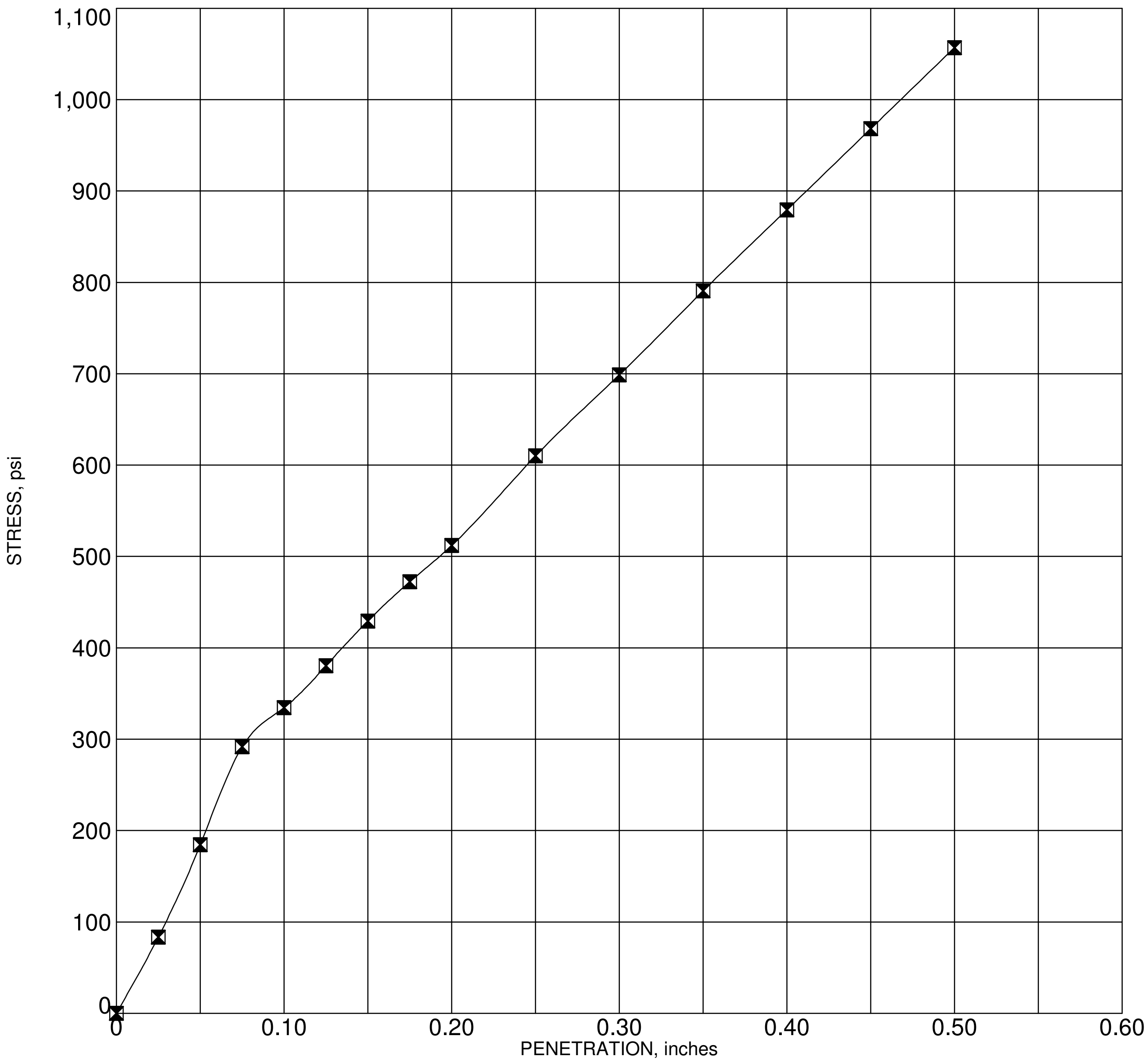
W.O. 8190-10

CALIFORNIA BEARING RATIO - ASTM D1883

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Plate
B - 5

G CBR 8190-10.GPJ GEOLABS.GDT 3/11/24



Corr. CBR @ 0.1"	33.4
Corr. CBR @ 0.2"	34.1
Swell (%)	0.11

Sample: Bulk-2
Depth: 1.0 - 5.0 feet
Description: Grayish brown clayey silt with some gravel

Molding Dry Density (pcf)	108.8	Hammer Wt. (lbs)	10
Molding Moisture (%)	19.7	Hammer Drop (inches)	18
Days Soaked	5	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

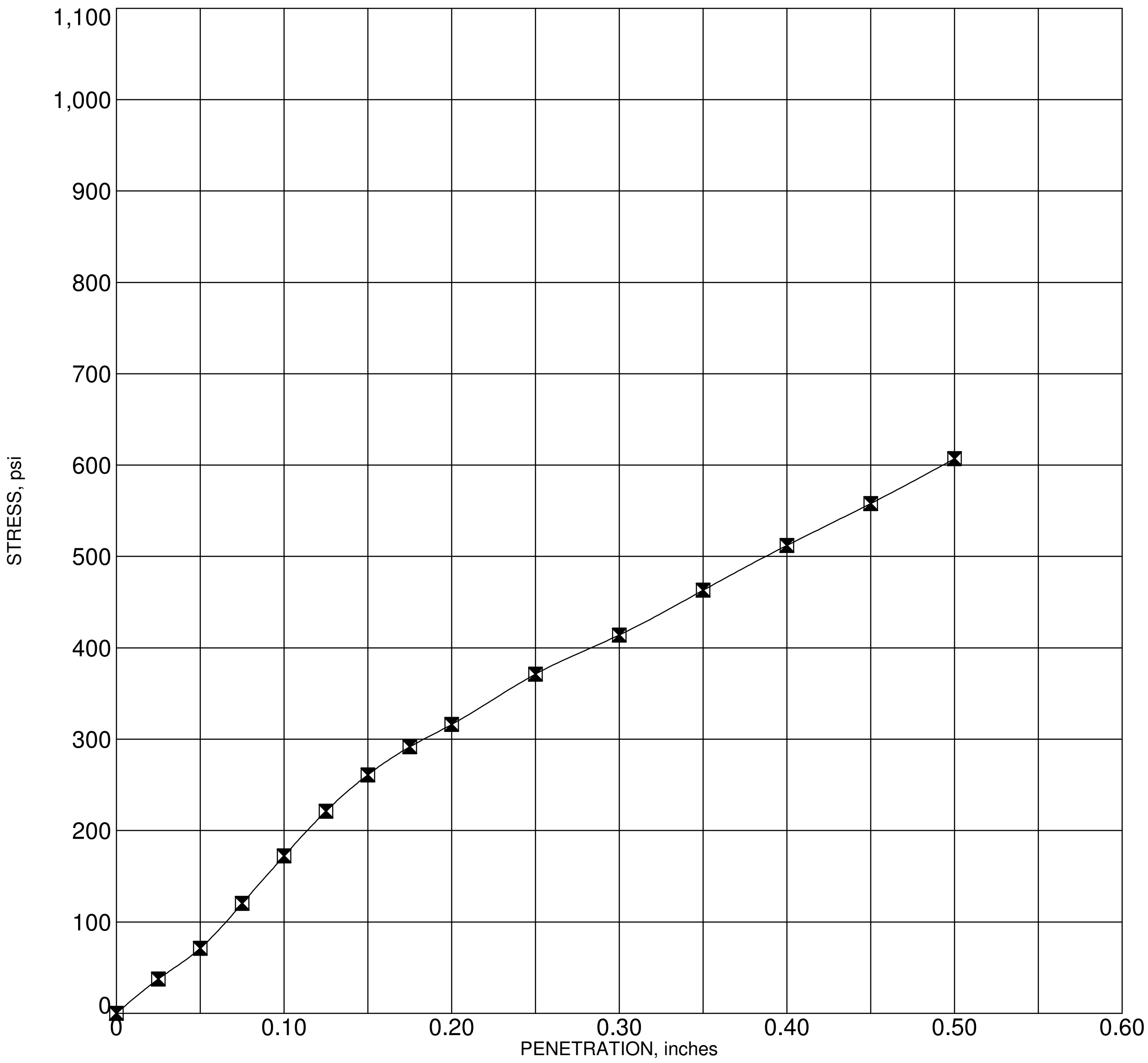
GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8190-10

CALIFORNIA BEARING RATIO - ASTM D1883

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Plate
B - 6

G_CBR 8190-10.GPJ GEOLABS.GDT 3/11/24



Corr. CBR @ 0.1"	17.2
Corr. CBR @ 0.2"	21.1
Swell (%)	0.26

Sample: Bulk-3
Depth: 0.0 - 2.0 feet
Description: Brown clayey silt with traces of gravel

Molding Dry Density (pcf)	95.4	Hammer Wt. (lbs)	10
Molding Moisture (%)	28.3	Hammer Drop (inches)	18
Days Soaked	3	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 8190-10

CALIFORNIA BEARING RATIO - ASTM D1883

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Plate
B - 7

G_CBR 8190-10.GPJ GEOLABS.GDT 3/11/24

Location	Depth (feet)	pH Value	Minimum Resistivity (ohm-cm)	Chloride Content (mg/kg)	Sulfate Content (mg/kg)
Bulk-1	0.0 - 2.0	6.92*	4600*	18	ND
Bulk-2	1.0 - 5.0	7.16*	6500*	ND	ND
Bulk-3	0.0 - 2.0	6.73*	2400*	ND	34

TEST METHODS (by Eurofins TestAmerica Laboratories, Inc.)

pH Value	Method 9045C
Minimum Resistivity	SM 2510B
Chloride Content	EPA 300.0
Sulfate Content	EPA 300.0

TEST METHODS (by Geolabs, Inc.)*

pH Value	ASTM G51
Minimum Resistivity	ASTM G57
Chloride Content	N/A
Sulfate Content	N/A

ND: Not Detected Within Reporting Limits

GEOLABS, INC.
GEOTECHNICAL ENGINEERING

W.O. 8190-10

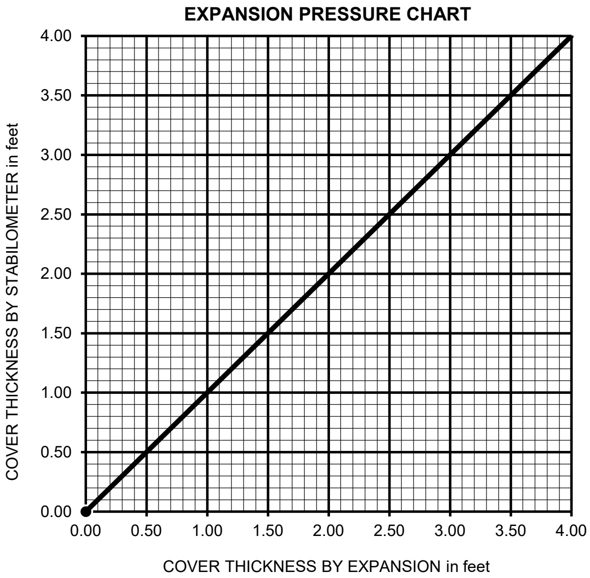
SUMMARY OF CORROSIVITY TESTS

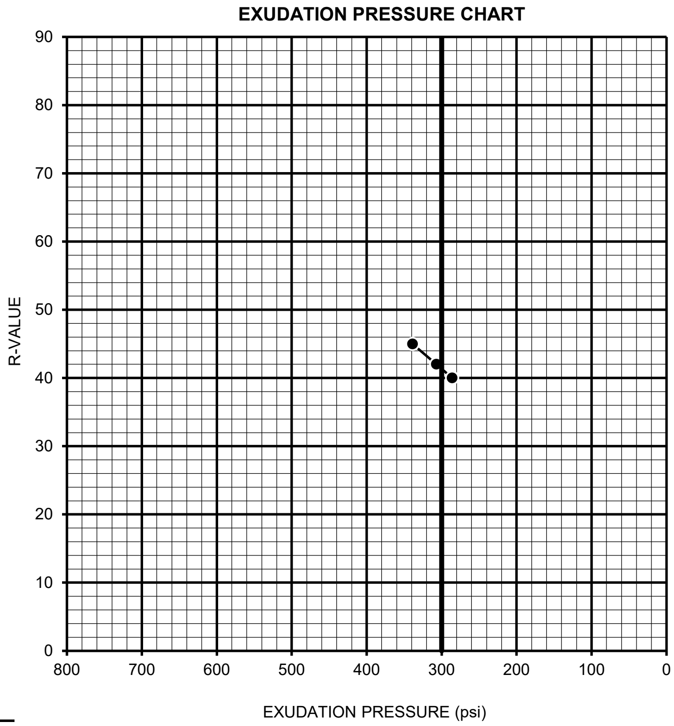
KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE
AND REALIGNMENT OF APPROACHES
FEDERAL-AID PROJECT NO. BR-NH-019-1(045)
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Plate
B - 8

TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION, %	30.5	31.0	31.5
HEIGHT OF SAMPLE, inches	2.45	2.44	2.54
DRY DENSITY, pcf	98.9	95.6	93.3
COMPACTOR AIR PRESSURE, psi	150	125	100
EXUDATION PRESSURE, psi	339	307	286
EXPANSION, inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	60	64	68
TURNS DISPLACEMENT	5.02	5.08	5.12
R-VALUE UNCORRECTED	45	42	40
R-VALUE CORRECTED	45	42	40

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT NEEDED, ft.	0.00	0.00	0.00
TRAFFIC INDEX	0.0		
STABILOMETER THICKNESS, ft.	#DIV/0!	#DIV/0!	#DIV/0!
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00





R-VALUE BY EXPANSION: NOT APPLICABLE

R-VALUE BY EXUDATION: 41

Sample Location	Depth (ft)	Job No.	Equilibrium R-Value
BULK #1	N/A	8190-10	41

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844/CT 301

169205

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

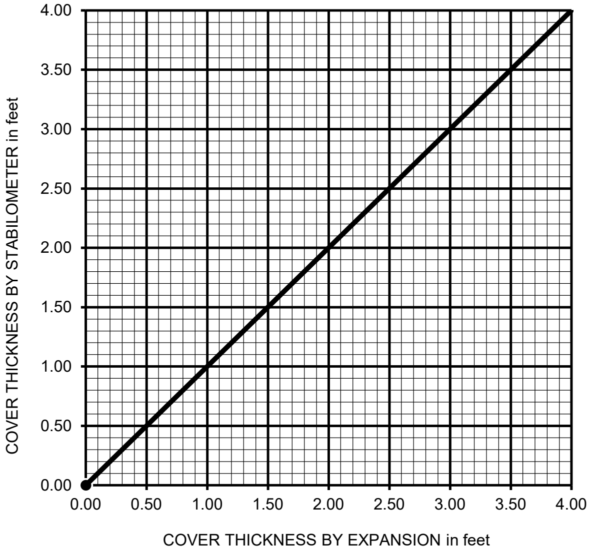
R-VALUE TEST RESULTS

GEOLABS INC.
WAIAKA STREAM BRIDGE
108026001 9/23

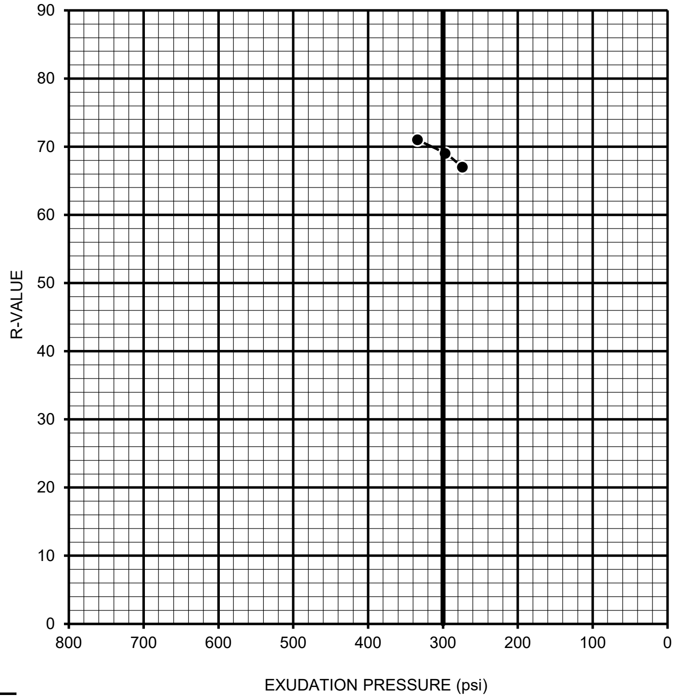
TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION, %	26.9	27.4	27.9
HEIGHT OF SAMPLE, inches	2.48	2.49	2.54
DRY DENSITY, pcf	103.6	101.8	97.3
COMPACTOR AIR PRESSURE, psi	250	225	200
EXUDATION PRESSURE, psi	334	297	274
EXPANSION, inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	27	29	32
TURNS DISPLACEMENT	4.91	4.96	5.03
R-VALUE UNCORRECTED	71	69	67
R-VALUE CORRECTED	71	69	67

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT NEEDED, ft.	0.00	0.00	0.00
TRAFFIC INDEX	0.0		
STABILOMETER THICKNESS, ft.	#DIV/0!	#DIV/0!	#DIV/0!
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00

EXPANSION PRESSURE CHART



EXUDATION PRESSURE CHART



R-VALUE BY EXPANSION: NOT APPLICABLE

R-VALUE BY EXUDATION: 69

Sample Location	Depth (ft)	Job No.	Equilibrium R-Value
BULK #2	N/A	8190-10	69

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844/CT 301

169206

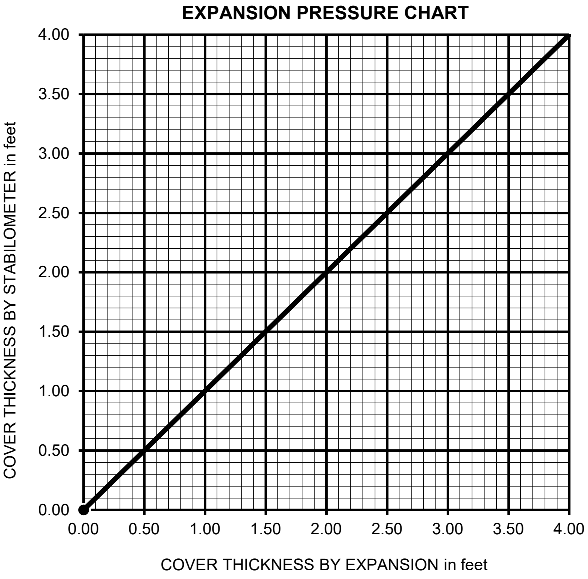
R-VALUE TEST RESULTS

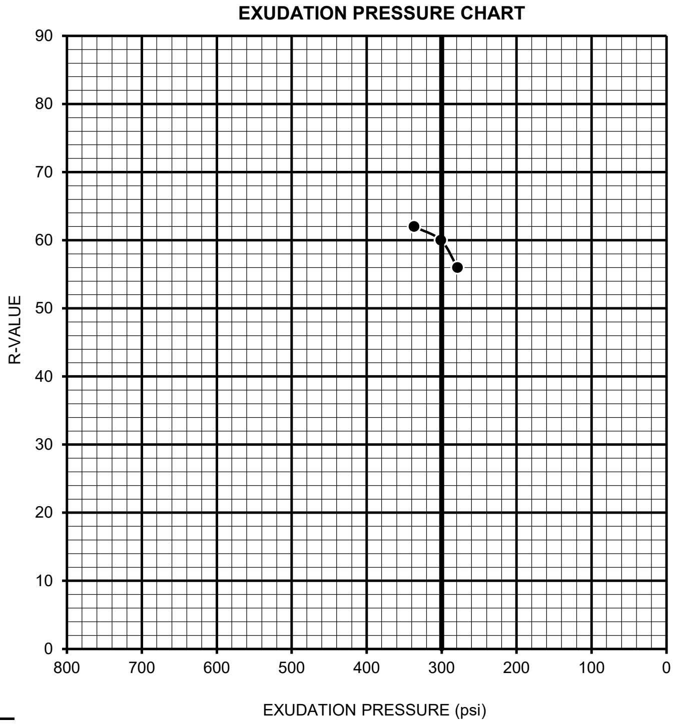
GEOLABS INC.
WAIAKA STREAM BRIDGE
108026001 9/23

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION, %	28.7	29.2	29.7
HEIGHT OF SAMPLE, inches	2.55	2.54	2.55
DRY DENSITY, pcf	96.6	94.5	92.4
COMPACTOR AIR PRESSURE, psi	200	200	200
EXUDATION PRESSURE, psi	337	301	279
EXPANSION, inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	38	40	45
TURNS DISPLACEMENT	4.92	4.96	4.99
R-VALUE UNCORRECTED	62	60	56
R-VALUE CORRECTED	62	60	56

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT NEEDED, ft.	0.00	0.00	0.00
TRAFFIC INDEX	0.0		
STABILOMETER THICKNESS, ft.	#DIV/0!	#DIV/0!	#DIV/0!
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00





R-VALUE BY EXPANSION: NOT APPLICABLE

R-VALUE BY EXUDATION: 60

Sample Location	Depth (ft)	Job No.	Equilibrium R-Value
BULK #3	N/A	8190-10	60

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844/CT 301

169207

R-VALUE TEST RESULTS

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

GEOLABS INC.
WAIAKA STREAM BRIDGE
108026001 9/23

APPENDIX C

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE AND REALIGNMENT OF APPROACHES
FEDERAL AID PROJECT NO. BR-NH-019-1(045)
DISTICT OF SOUTH KOHALA, ISLAND OF HAWAII

B-101 11.0’ TO 29.5’

11.0’ 21.0’

21.0’ 29.5’

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE AND REALIGNMENT OF APPROACHES
FEDERAL AID PROJECT NO. BR-NH-019-1(045)
DISTICT OF SOUTH KOHALA, ISLAND OF HAWAII

B-101 29.5’ TO 50.5’

29.5’

42.5’

42.5’

50.5’

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE AND REALIGNMENT OF APPROACHES
FEDERAL AID PROJECT NO. BR-NH-019-1(045)
DISTICT OF SOUTH KOHALA, ISLAND OF HAWAII

B-102 4.0' TO 36.5'

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE AND REALIGNMENT OF APPROACHES
FEDERAL AID PROJECT NO. BR-NH-019-1(045)
DISTICT OF SOUTH KOHALA, ISLAND OF HAWAII

B-102 36.5’ TO 52.5’

36.5’ **45.0'**

45.0’ **52.5’**

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE AND REALIGNMENT OF APPROACHES
FEDERAL AID PROJECT NO. BR-NH-019-1(045)
DISTICT OF SOUTH KOHALA, ISLAND OF HAWAII

B-103 6.25’ TO 29.5’

6.25’ 20.0'

20.0’ 29.5’

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE AND REALIGNMENT OF APPROACHES
FEDERAL AID PROJECT NO. BR-NH-019-1(045)
DISTICT OF SOUTH KOHALA, ISLAND OF HAWAII

B-103 29.5’ TO 52.5’

29.5’ **47.0'**

47.0’ **52.5’**

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE AND REALIGNMENT OF APPROACHES
FEDERAL AID PROJECT NO. BR-NH-019-1(045)
DISTICT OF SOUTH KOHALA, ISLAND OF HAWAII

B-104 5.75' TO 24.5'

5.75’ 15.0'

15.0’ 24.5’

KAWAIHAE ROAD
REPLACEMENT OF WAIAKA BRIDGE AND REALIGNMENT OF APPROACHES
FEDERAL AID PROJECT NO. BR-NH-019-1(045)
DISTICT OF SOUTH KOHALA, ISLAND OF HAWAII

B-104 24.5’ TO 51.5’

24.5’ 42.5’

42.5’ 51.5’

APPENDIX D

TRAFFIC INDEX DETERMINATION

Project: Kawaihae Road
Replacement of Waiaka Bridge
And Realignment of Approaches
District of South Kohala, Island of Hawaii

Street Name: Kawaihae Road and Kohala Mountain Road

(1)	Design Period (years)	30
(2)	Current Average Daily Traffic (ADT) Per Direction	5802
(3)	Future Average Daily Traffic (ADT) Per Direction	6660
(4)	Average ADT Per Direction Over Design Period	6231
(5)	Design Lane Factor	1

Number of Lanes In One Direction	Design Lane Factor
1	1
2	1
3	0.8
4	0.75

(6) 24-Hour Truck Traffic, T_{24} (%) 5.9

Truck Traffic Distribution :

2-axle = 67.84%
3-axle = 10.39%
4-axle = 2.55%
5-axle = 18.71%
6-axle = 0.49%
7-axle = 0.01%

(7) Average Daily Truck Traffic Per Direction, ADTT 368

(8) Equivalent 18-kip Single Axle Loads, ESAL

2-axle : % of 2-axle trucks x No. trucks x 65	=	16211
3-axle : % of 3-axle trucks x No. trucks x 525	=	20053
4-axle : % of 4-axle trucks x No. trucks x 1162	=	10893
5-axle : % of 5-axle trucks x No. trucks x 1462	=	100561
6-axle : % of 6-axle trucks x No. trucks x 968	=	1779

Annual ESAL : = 149,497

Total ESAL For Design Period = 4,484,913

TRAFFIC INDEX (TI) = 9 (ESAL/1,000,000)EXP(0.119) 10.76

SAY 11.0

Project: Kawaihae Road
Replacement of Waiaka Bridge
And Realignment of Approaches
District of South Kohala, Island of Hawaii

Street: Kawaihae Road and Kohala Mountain Road

Design Parameters

Traffic Index	11.0
R value of ACB	90
R value of ASB	60
R value of Subgrade	44

Pavement Section using Asphalt Concrete Base and Aggregate Subbase

Trial Thickness of AC + ACB 10 Inches

(1) Asphalt Concrete (AC)

GE required					0.352	
GE with Tolerance =	0.352	+	0.240	=	0.592	
Gf of AC					1.987	
GE/Gf	=	3.57		SAY	4.000	Inches
				USE	4.000	Inches

(2) Asphalt Concrete Base (ACB)

GE required	=			1.408	
GE of AC	=			0.422	
GE required of ACB	=			0.986	
Gf of ACB				1.888	
GE/Gf	=	6.26	SAY	6.50	Inches
			USE	7.00	Inches

(3) Calculate New Gf of AC

Thickness of AC + Thickness of ACB	0.833
New Gf of AC	1.987
New Gf of ACB	1.888

(4) Aggregate Subbase (ASB)

GE required	=			1.971	
GE of AC	=			0.422	
GE of ACB	=			0.944	
GE required of ASB	=			0.605	
GE less tolerance	=			0.365	
Gf of ASB	=			1.000	
GE/Gf	=	4.38	SAY	6.00	Inches
			USE	6.00	Inches

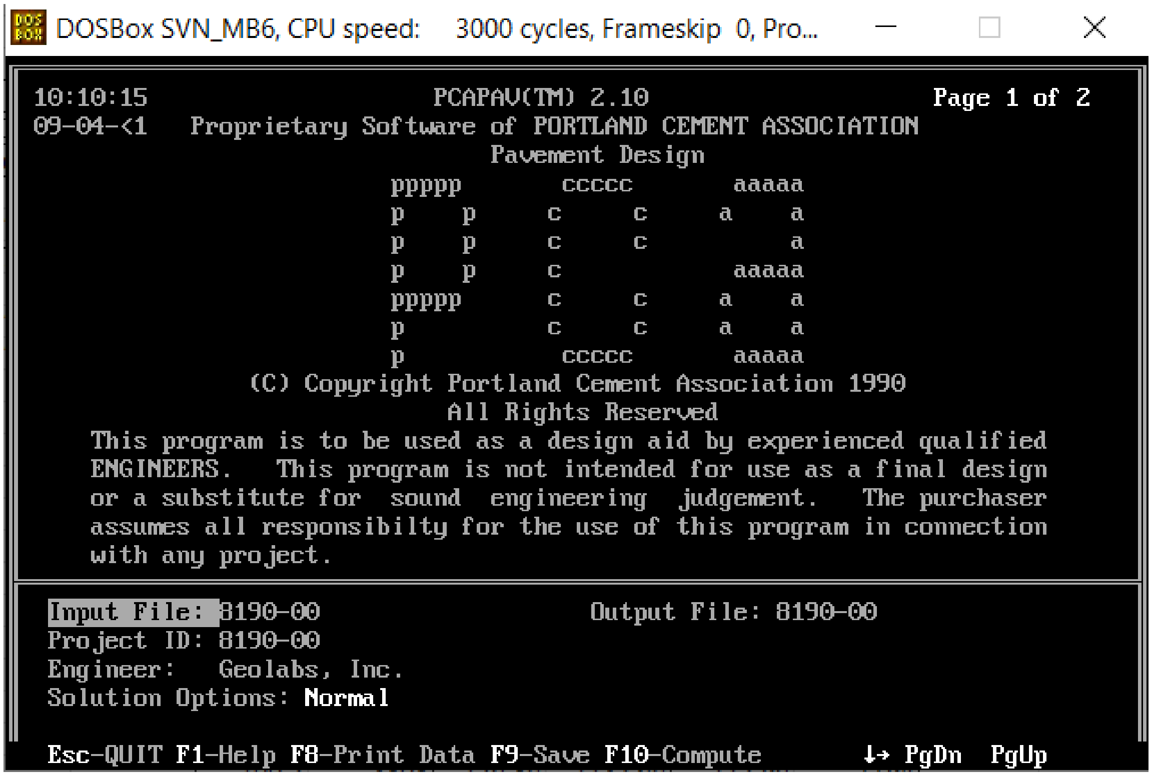
Design Pavement Section

4.0	**Inches**	**AC**
7.0	**Inches**	**ACB**
6.0	**Inches**	**ASB**
17.0	**Inches**	**Total Thickness**

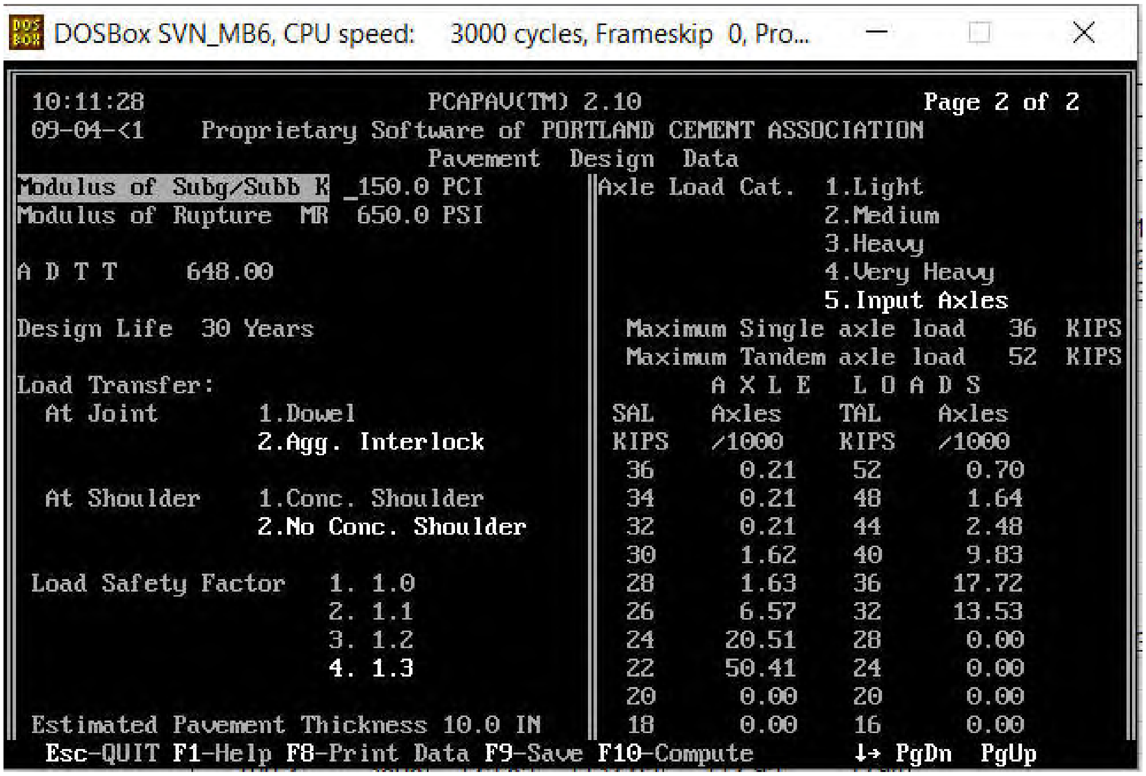
Kawaihae Road
Replacement of Waiaka Bridge
And Realignment of Approaches
District of South Kohala, Island of Hawaii

Design Period = 30 years (One-Way Traffic)

	2 Axles		3 Axles		4 Axles		5 Axles		6 Axles		TOTAL
Single Axle	ADTT= 250		ADTT= 38		ADTT= 9		ADTT= 69		ADTT= 2		ADTT= 368
Loads (kips)	Factors	Repetition	Factors	Repetition	Factors	Repetition	Factors	Repetition	Factors	Repetition	REPETITIONS
20-22	103.5	25875	183.75	6983	1063.8	9574.2	2,273.10	156844	1933.05	3866.1	203142
22-24	72.15	18038	26.85	1020	1339.5	12055.5	646.35	44598	3464.1	6928.2	82640
24-26	52.2	13050	11.25	428	909.45	8185.05	51	3519	651.15	1302.3	26484
26-28	10.05	2513	8.4	319	345.15	3106.35	9	621			6559
28-30	10.05	2513	8.1	308	343.8	3094.2	9	621			6536
30-32			7.35	279	64.2	577.8					857
32-34			7.35	279	63	567					846
34-36			7.35	279	63	567					846
Tandem Axle Loads (kips)											
30-32			761.1	28922	609.15	5482.35	272.85	18827	651.15	1302.3	54533
32-34			555.6	21113	439.8	3958.2	312.15	21538			46609
34-36			156.9	5962	561.15	5050.35	199.65	13776			24788
36-38			156.9	5962	188.1	1692.9	278.7	19230			26885
38-40			100.2	3808	125.85	1132.65	112.95	7794			12734
40-42			44.4	1687	83.7	753.3	60.15	4150			6591
42-44					83.7	753.3	38.4	2650			3403
44-46					40.8	367.2	49.65	3426			3793
46-48			5.7	217			37.5	2588			2804
48-50			5.7	217			37.5	2588			2804

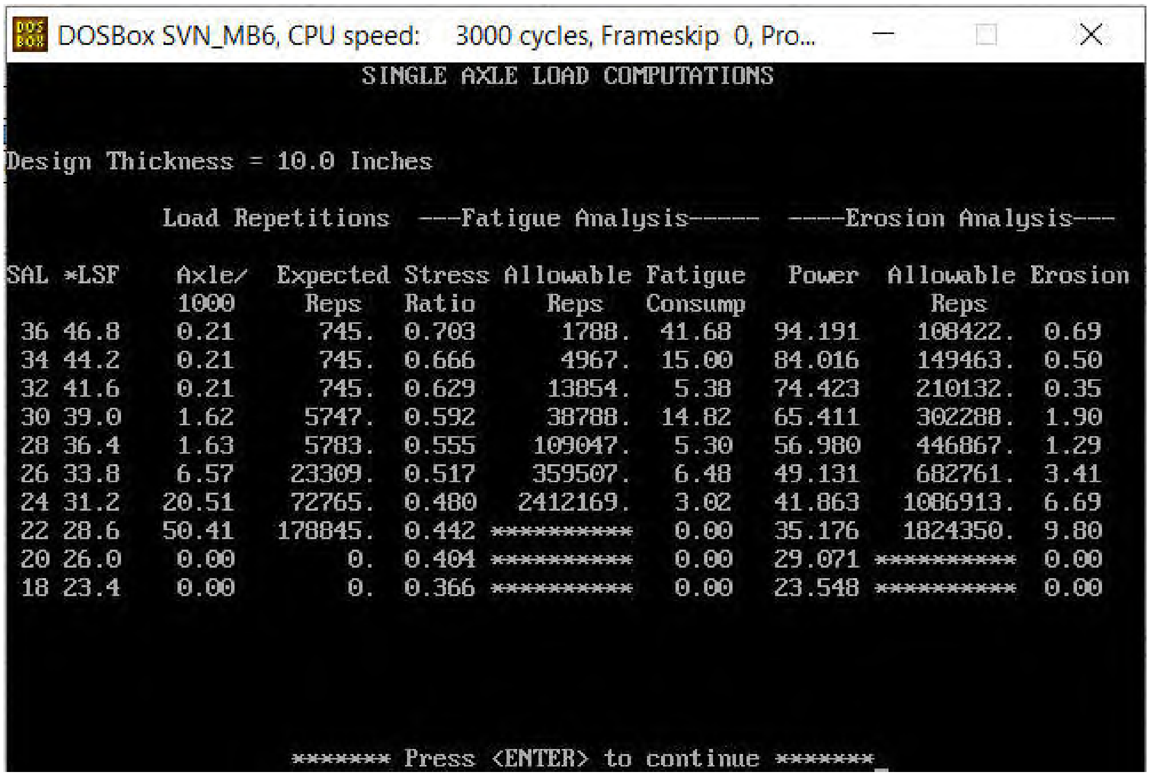


```
10:10:15                  PCAPAV(TM) 2.10                    Page 1 of 2
09-04-<1   Proprietary Software of PORTLAND CEMENT ASSOCIATION
                            Pavement Design
                          ppppp      ccccc      aaaaa
                          p    p    c     c    a     a
                          p    p    c     c          a
                          p    p    c           aaaaa
                          ppppp     c     c    a     a
                          p         c     c    a     a
                          p          ccccc      aaaaa
                (C) Copyright Portland Cement Association 1990
                             All Rights Reserved
    This program is to be used as a design aid by experienced qualified
    ENGINEERS.  This program is not intended for use as a final design
    or a substitute for  sound  engineering  judgement.   The purchaser
    assumes all responsibilty for the use of this program in connection
    with any project.

  Input File: 8190-00                    Output File: 8190-00
  Project ID: 8190-00
  Engineer:   Geolabs, Inc.
  Solution Options: Normal

  Esc-QUIT F1-Help F8-Print Data F9-Save F10-Compute       ↓→ PgDn  PgUp
```

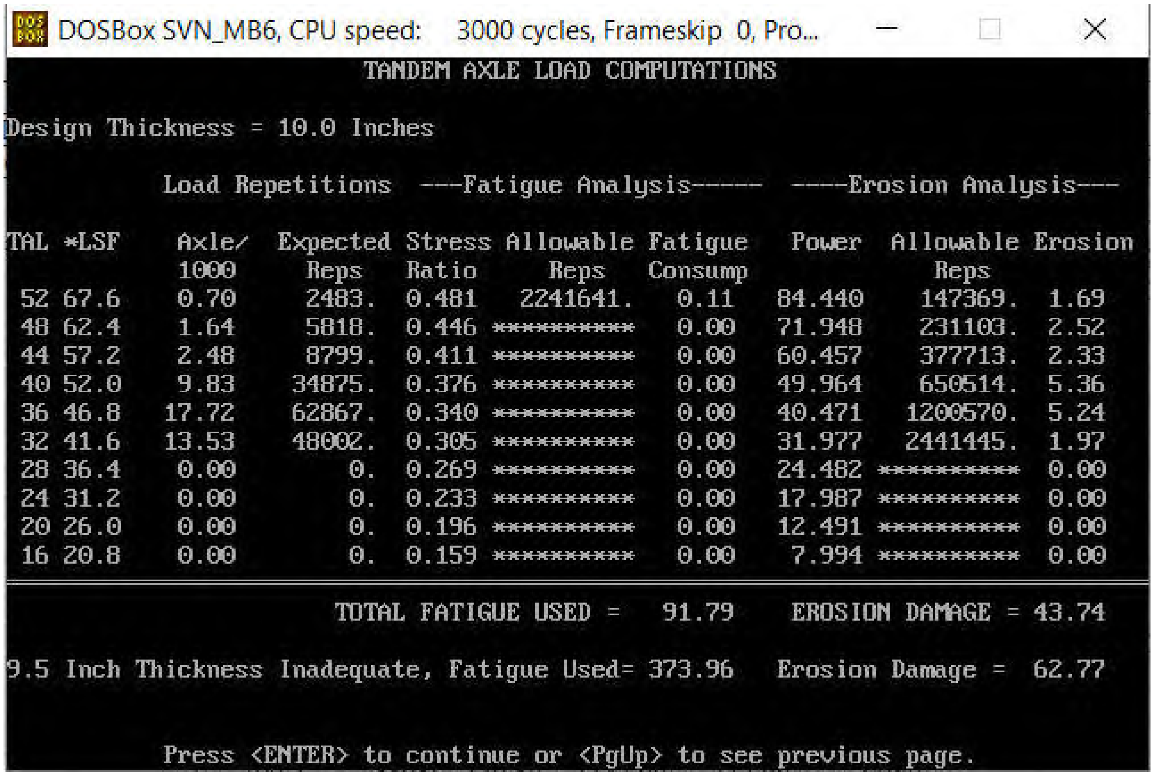


```
 10:11:28                 PCAPAV(TM) 2.10                   Page 2 of 2
 09-04-<1   Proprietary Software of PORTLAND CEMENT ASSOCIATION
                         Pavement  Design  Data
Modulus of Subg/Subb K _150.0 PCI    ║Axle Load Cat.  1.Light
Modulus of Rupture  MR  650.0 PSI    ║                2.Medium
                                     ║                3.Heavy
A D T T     648.00                   ║                4.Very Heavy
                                     ║                5.Input Axles
Design Life  30 Years                ║  Maximum Single axle load   36  KIPS
                                     ║  Maximum Tandem axle load   52  KIPS
Load Transfer:                       ║        A X L E   L O A D S
  At Joint        1.Dowel            ║ SAL    Axles     TAL     Axles
                  2.Agg. Interlock   ║ KIPS   /1000     KIPS    /1000
                                     ║  36     0.21     52       0.70
  At Shoulder     1.Conc. Shoulder   ║  34     0.21     48       1.64
                  2.No Conc. Shoulder║  32     0.21     44       2.48
                                     ║  30     1.62     40       9.83
 Load Safety Factor   1. 1.0         ║  28     1.63     36      17.72
                      2. 1.1         ║  26     6.57     32      13.53
                      3. 1.2         ║  24    20.51     28       0.00
                      4. 1.3         ║  22    50.41     24       0.00
                                     ║  20     0.00     20       0.00
 Estimated Pavement Thickness 10.0 IN║  18     0.00     16       0.00
  Esc-QUIT F1-Help F8-Print Data F9-Save F10-Compute      ↓→ PgDn  PgUp
```

Kawaihae Road
Replacement of Waiaka Bridge
And Realignment of Approaches
District of South Kohala, Island of Hawaii



```
                         SINGLE AXLE LOAD COMPUTATIONS


Design Thickness = 10.0 Inches

           Load Repetitions  ---Fatigue Analysis------  ----Erosion Analysis---

SAL *LSF     Axle/  Expected Stress Allowable Fatigue   Power  Allowable Erosion
             1000     Reps   Ratio     Reps   Consump            Reps
 36 46.8     0.21      745.  0.703      1788.  41.68   94.191   108422.  0.69
 34 44.2     0.21      745.  0.666      4967.  15.00   84.016   149463.  0.50
 32 41.6     0.21      745.  0.629     13854.   5.38   74.423   210132.  0.35
 30 39.0     1.62     5747.  0.592     38788.  14.82   65.411   302288.  1.90
 28 36.4     1.63     5783.  0.555    109047.   5.30   56.980   446867.  1.29
 26 33.8     6.57    23309.  0.517    359507.   6.48   49.131   682761.  3.41
 24 31.2    20.51    72765.  0.480   2412169.   3.02   41.863  1086913.  6.69
 22 28.6    50.41   178845.  0.442 **********   0.00   35.176  1824350.  9.80
 20 26.0     0.00        0.  0.404 **********   0.00   29.071 **********  0.00
 18 23.4     0.00        0.  0.366 **********   0.00   23.548 **********  0.00





                    ******* Press <ENTER> to continue *******_
```



```
                         TANDEM AXLE LOAD COMPUTATIONS

Design Thickness = 10.0 Inches

           Load Repetitions  ---Fatigue Analysis------  ----Erosion Analysis---

TAL *LSF     Axle/  Expected Stress Allowable Fatigue   Power  Allowable Erosion
             1000     Reps   Ratio     Reps   Consump            Reps
 52 67.6     0.70     2483.  0.481   2241641.   0.11   84.440   147369.  1.69
 48 62.4     1.64     5818.  0.446 **********   0.00   71.948   231103.  2.52
 44 57.2     2.48     8799.  0.411 **********   0.00   60.457   377713.  2.33
 40 52.0     9.83    34875.  0.376 **********   0.00   49.964   650514.  5.36
 36 46.8    17.72    62867.  0.340 **********   0.00   40.471  1200570.  5.24
 32 41.6    13.53    48002.  0.305 **********   0.00   31.977  2441445.  1.97
 28 36.4     0.00        0.  0.269 **********   0.00   24.482 **********  0.00
 24 31.2     0.00        0.  0.233 **********   0.00   17.987 **********  0.00
 20 26.0     0.00        0.  0.196 **********   0.00   12.491 **********  0.00
 16 20.8     0.00        0.  0.159 **********   0.00    7.994 **********  0.00

                       TOTAL FATIGUE USED =    91.79    EROSION DAMAGE = 43.74

9.5 Inch Thickness Inadequate, Fatigue Used= 373.96    Erosion Damage =   62.77


           Press <ENTER> to continue or <PgUp> to see previous page.
```

ECONOMIC JUSTIFICATION

PROJECT: Kawaihae Road
Replacement of Waiaka Bridge
And Realignment of Approaches
District of South Kohala, Island of Hawaii

Unit Prices:		**In-Place Costs**
1	Asphalt Concrete Pavement (AC) - per ton	$ 200.00
2	Asphalt Concrete Base (ACB) - per ton	$ 185.00
3	Asphalt Treated Permeable Base (ATPB) - per ton	$ 185.00
4	Cement Treated Permeable Base (CTPB) - per cubic yard	$ 140.00
5	Untreated Permeable Base (UTPB) - per cubic yard	$ 100.00
6	Aggregate Base (AB) - per cubic yard	$ 100.00
7	Aggregate Subbase (ASB) - per cubic yard	$ 80.00
8	Portland Cement Concrete Pavement (PCC) - per cubic yard	$ 450.00
9	Roadway Excavation - per cubic yard	$ 50.00
10	Cold Planing of Existing AC - per cubic yard	$ 72.00
11	AC Overlay - per ton	$ 215.00
12	Retexturing of Concrete Pavement - per square yard	$ 30.00

Assumptions/Limitations:

1. The new pavement sections are based on the current HDOT design guidelines

2. HDOT Conversion Factors:

Asphalt Concrete Pavement (Mix IV):	2.07 Tons/cubic yard
Asphalt Concrete Base:	2.12 Tons/cubic yard
Asphalt Treated Permeable Base:	2.19 Tons/cubic yard

3. Assume cold-plane and overlay 2.0 inches of AC every 7 to 8 years for AC pavement with untreated bases
Assume cold-plane and overlay 2.0 inches of AC every 10 to 12 years for AC pavement with treated bases
Assume retexturing PCC pavements every 30 years

4. Economic analysis based on excavated pavement sections.

5. Assume rate of inflation at 6 percent per year.

6. Assume rate of discount at 6 percent per year.

A. AC Pavement Section with ACB over ASB

New Pavement Section: 4.0" AC, 7.0" ACB, 6.0" ASB

Initial Cost

Items	Thickness (inches)	Quantity (cy/sy)	Unit Price	Cost Per Square Yard
AC	4	0.11	$ 200.00	$ 46.00
ACB	6	0.17	$ 185.00	$ 65.37
ATPB	0	0.00	$ 185.00	$ -
CTPB	0	0.00	$ 140.00	$ -
UTPB	0	0.00	$ 100.00	$ -
AB	0	0.00	$ 100.00	$ -
ASB	6	0.17	$ 80.00	$ 13.33
Roadway Excavation	16	0.44	$ 50.00	$ 22.22
			Total Initial Cost	$ 146.92

Maintenance Cost

Year	Items	Thickness (inches)	Quantity (cy/sy)	Present Unit Price	Inflated Unit Price	Inflated Cost Per Sq. Yd.	Present Cost Per Sq. Yd.
10	Cold-Planing	2.0	0.06	$ 72.00	$ 128.94	$ 7.16	$ 4.00
	AC Overlay	2.0	0.06	$ 215.00	$ 385.03	$ 44.28	$ 24.73
20	Cold-Planing	2.0	0.06	$ 72.00	$ 230.91	$ 12.83	$ 4.00
	AC Overlay	2.0	0.06	$ 215.00	$ 689.53	$ 79.30	$ 24.73
Number of Overlay =	4			**Total Maint. Cost**			$ 57.45

OPTION A: **TOTAL COST** **$ 204.37**

B. PCC Pavement (650 psi flexural strenth)

New Pavement Section: 10.0" PCC over 6.0" ASB

Initial Cost

Items	Thickness (inches)	Quantity (cy/sy)	Unit Price	Cost Per Square Yard
PCC	10	0.28	$ 450.00	$ 125.00
ACB	0	0.00	$ 185.00	$ -
ATPB	0	0.00	$ 185.00	$ -
CTPB	0	0.00	$ 140.00	$ -
UTPB	0	0.00	$ 100.00	$ -
AB	0	0.00	$ 100.00	$ -
ASB	6	0.17	$ 80.00	$ 13.33
Roadway Excavation	16	0.44	$ 50.00	$ 22.22
			Total Cost	$ 160.56

Maintenance Cost

Year	Items	Inflated Cost Per Sq. Yd.	Present Cost Per Sq. Yd.
20	Re-Texturing of Concrete Pavement	$ 96.21	$ 30.00

OPTION B:	**TOTAL COST**	**$ 190.56**

Pavement Cost Comparison

OPTION A:	**$ 204.37**
OPTION B:	**$ 190.56**

TRAFFIC INDEX DETERMINATION

Project: Kawaihae Road
Replacement of Waiaka Bridge
And Realignment of Approaches
District of South Kohala, Island of Hawaii

Street Name: Kawaihae Road and Kohala Mountain Road

(1) Design Period (years) 2

(2) Current Average Daily Traffic (ADT) Per Direction 5802

(3) Future Average Daily Traffic (ADT) Per Direction 5860

(4) Average ADT Per Direction Over Design Period 5831

(5) Design Lane Factor 1

Number of Lanes In One Direction	Design Lane Factor
1	1
2	1
3	0.8
4	0.75

(6) 24-Hour Truck Traffic, T_{24} (%) 5.9

Truck Traffic Distribution :
2-axle = 67.84%
3-axle = 10.39%
4-axle = 2.55%
5-axle = 18.71%
6-axle = 0.49%
7-axle = 0.01%

(7) Average Daily Truck Traffic Per Direction, ADTT 344

(8) Equivalent 18-kip Single Axle Loads, ESAL
2-axle : % of 2-axle trucks x No. trucks x 65 = 15170
3-axle : % of 3-axle trucks x No. trucks x 525 = 18766
4-axle : % of 4-axle trucks x No. trucks x 1162 = 10194
5-axle : % of 5-axle trucks x No. trucks x 1462 = 94107
6-axle : % of 6-axle trucks x No. trucks x 968 = 1665

Annual ESAL : = 139,902

Total ESAL For Design Period = 279,805

TRAFFIC INDEX (TI) = 9 (ESAL/1,000,000)EXP(0.119) 7.73

SAY 7.5

Project: Kawaihae Road
Replacement of Waiaka Bridge
And Realignment of Approaches
District of South Kohala, Island of Hawaii

Street: Kawaihae Road and Kohala Mountain Road

Design Parameters

Traffic Index	7.5
R value of ACB	90
R value of Subgrade	44

Pavement Section using Asphalt Concrete Base

Trial Thickness of AC + ACB 8 Inches

(1)	**Asphalt Concrete (AC)**						
	GE required					0.240	
	GE with Tolerance =	0.240	+	0.240	=	0.480	
	Gf of AC					2.236	
	GE/Gf	=	2.58		SAY	3.00	Inches
					USE	3.00	Inches

(2)	**Asphalt Concrete Base (ACB)**						
	GE required	=				1.344	
	GE of AC	=				0.319	
	GE required of ACB	=				1.025	
	GE less tolerance	=				0.785	
	Gf of ACB					2.124	
	GE/Gf	=	4.43		SAY	4.50	Inches
					USE	5.00	Inches

(3)	**Calculate New Gf of AC**	
	Thickness of AC + Thickness of ACB	0.667
	New Gf of AC	2.236

Design Pavement Section

3.0	**Inches**	**AC**
5.0	**Inches**	**ACB**
8.0	**Inches**	**Total Thickness**

Project: Kawaihae Road
Replacement of Waiaka Bridge
And Realignment of Approaches
District of South Kohala, Island of Hawaii

Street: Kawaihae Road and Kohala Mountain Road

Design Parameters

Traffic Index	7.5
R value of AB	80
R value of Subgrade	44

Pavement Section using Aggregate Base Course

(1) **Asphalt Concrete (AC)**

GE required					0.480	
GE with Tolerance =	0.480	+	0.200	=	0.680	
Gf of AC					2.059	
GE/Gf	=	3.96		SAY	4.00	Inches
				USE	3.00	Inches

(2) **Aggregate Base Course (AB)**

GE required	=				1.344	
GE of AC	=				0.315	
GE required of AB	=				1.029	
GE less tolerance	=				0.829	
Gf of AB					1.100	
GE/Gf	=	9.05		SAY	10.00	Inches
				USE	10.00	Inches

Design Pavement Section

3.0	**Inches**	**AC**
10.0	**Inches**	**AB**
13.0	**Inches**	**Total Thickness**

APPENDIX E

GEOLABS, INC.

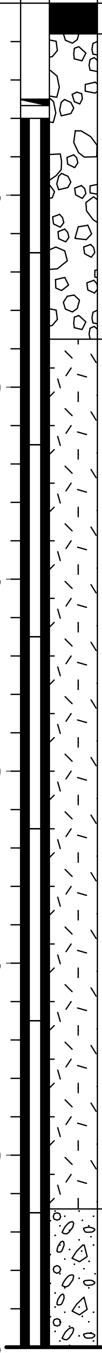
Geotechnical Engineering

KAWAIHAE ROAD - WAIAKA BRIDGE REPLACEMENT
AND REALIGNMENT OF APPROACHES
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Log of Boring

1

Approximate Ground Surface Elevation (feet MSL): 2418 *



Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
									10-inch **ASPHALTIC CONCRETE**
									Gray with brown mottling **GRAVELLY COBBLES (BASALTIC)** with some boulders and a little sand and silt, medium dense to dense, dry to moist (fill)
	39 14	45			50/2"				
			48	0					
							5		grades to very dense
			95	55					
									Gray vugular **BASALT**, slightly to moderately fractured, unweathered to slightly weathered, hard to very hard (a'a basalt)
UC= 5400 psi									
							10		
UC= 22120 psi			100	80					
									grades to dense
UC= 33460 psi									
							15		
			100	55					
UC= 32290 psi							20		
			100	88					
UC= 19000 psi									
							25		
			100	67					
							30		
			30	0				GW	Gray subangular **SANDY GRAVEL (BASALTIC)** with a little cobbles, medium dense, moist (clinker)
							35		

Date Started:	July 28, 2021
Date Completed:	July 28, 2021
Logged By:	S. Latronic
Total Depth:	50 feet
Work Order:	8190-00

Water Level: ▼	Not Encountered
Drill Rig:	MOBILE B-53.1 *(Energy Transfer Ratio = 42.9%)*
Drilling Method:	4" Solid-Stem Auger & HQ Coring
Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 1.1

GEOLABS, INC.

Geotechnical Engineering

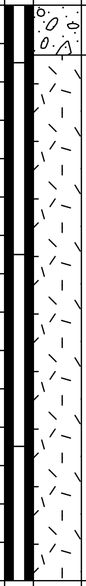
KAWAIHAE ROAD - WAIAKA BRIDGE REPLACEMENT
AND REALIGNMENT OF APPROACHES
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Log of Boring

1

(Continued from previous plate)

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
										GW	
			100	93							Reddish gray to gray vugular **BASALT**, moderately fractured, unweathered to slightly weathered, hard to very hard (a'a basalt)
							40				
			100	80							
							45				
			100	83							
							50				Boring terminated at 50 feet * Elevations estimated from Draft Conceptual Plan by WSP dated April 20, 2022.
							55				
							60				
							65				
							70				



Date Started:	July 28, 2021
Date Completed:	July 28, 2021
Logged By:	S. Latronic
Total Depth:	50 feet
Work Order:	8190-00

Water Level: ▼	Not Encountered
Drill Rig:	MOBILE B-53.1 *(Energy Transfer Ratio = 42.9%)*
Drilling Method:	4" Solid-Stem Auger & HQ Coring
Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 1.2

GEOLABS, INC.

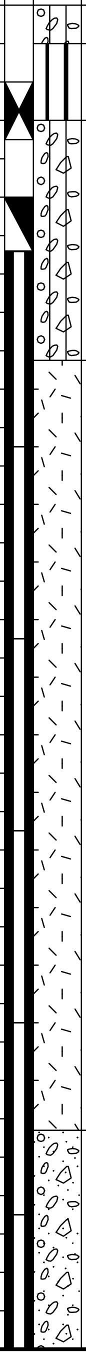
Geotechnical Engineering

KAWAIHAE ROAD - WAIAKA BRIDGE REPLACEMENT
AND REALIGNMENT OF APPROACHES
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Log of Boring

2

Approximate Ground Surface Elevation (feet MSL): 2418 *



Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
										GM	Gray with brown mottling angular **SILTY GRAVEL (BASALTIC)**, medium dense, dry (fill)
										ML	Brown **SANDY SILT** with a little gravel, very stiff, dry (volcanic ash)
Sieve - #200 = 62.0%	20	67			107						
										GM	Gray with brown mottling **SILTY GRAVEL (BASALTIC)** with some sand and cobbles, dense to very dense, dry to moist (clinker)
Sieve - #200 = 24.9%	17				49/6" +50/5"		5				
			69	23							
											grades to welded clinker
							10				Gray vugular **BASALT**, slightly to moderately fractured, unweathered to slightly weathered, hard to very hard (a'a basalt)
UC= 7660 psi UC= 8390 psi			100	95							
							15				
UC= 9710 psi UC= 12700 psi			100	100							grades to dense and massive locally
UC= 25660 psi							20				
			100	98							
							25				
			72	33							
							30			GW	Gray with reddish brown mottling subangular **SANDY GRAVEL (BASALTIC)** with a little cobbles, medium dense, moist (clinker)
			27								
							35				

Date Started: July 27, 2021
Date Completed: July 28, 2021
Logged By: S. Latronic
Total Depth: 51.5 feet
Work Order: 8190-00

Water Level: ▼ Not Encountered
Drill Rig: MOBILE B-53.1 *(Energy Transfer Ratio = 42.9%)*
Drilling Method: 4" Solid-Stem Auger & HQ Coring
Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 2.1

GEOLABS, INC.

Geotechnical Engineering

KAWAIHAE ROAD - WAIAKA BRIDGE REPLACEMENT
AND REALIGNMENT OF APPROACHES
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Log of Boring

2

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	(Continued from previous plate) Description
			75	35						GW	grades to welded clinker
			100	88			40				Gray vugular **BASALT**, slightly to moderately fractured, unweathered to slightly weathered, hard to very hard (a'a basalt)
			100	72			45				
							50				
											Boring terminated at 51.5 feet
							55				
							60				
							65				
							70				

Date Started:	July 27, 2021	Water Level: ▼	Not Encountered	Plate
Date Completed:	July 28, 2021			
Logged By:	S. Latronic	Drill Rig:	MOBILE B-53.1 *(Energy Transfer Ratio = 42.9%)*	A - 2.2
Total Depth:	51.5 feet	Drilling Method:	4" Solid-Stem Auger & HQ Coring	
Work Order:	8190-00	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC. Geotechnical Engineering	KAWAIHAE ROAD - WAIAKA BRIDGE REPLACEMENT AND REALIGNMENT OF APPROACHES DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII	**Log of Boring** 3

Laboratory			Field								Approximate Ground Surface Elevation (feet MSL): 2408 *
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											12-inch **ASPHALTIC CONCRETE**
	5				50/1"					ML	Brown **SANDY SILT** with some gravel (basaltic), hard, dry to moist (volcanic ash)
	20				43						
	16				50/4"		5				grades with cobbles (basaltic)
											Gray and brown **GRAVELLY COBBLES (BASALTIC)** in a sandy silt matrix, very dense, dry to moist (clinker)
	9				50/1"		10				grades to welded clinker
											Boring terminated at 10.1 feet
							15				
							20				
							25				
							30				
							35				

Date Started:	July 26, 2021	Water Level: ▼	Not Encountered	Plate A - 3
Date Completed:	July 26, 2021			
Logged By:	S. Latronic	Drill Rig:	MOBILE B-53.1 *(Energy Transfer Ratio = 42.9%)*	
Total Depth:	10.1 feet	Drilling Method:	4" Solid-Stem Auger	
Work Order:	8190-00	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC.

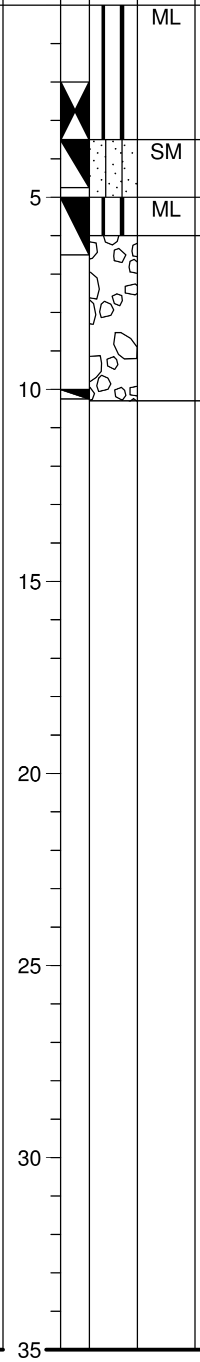
Geotechnical Engineering

KAWAIHAE ROAD - WAIAKA BRIDGE REPLACEMENT
AND REALIGNMENT OF APPROACHES
DISTRICT OF SOUTH KOHALA, ISLAND OF HAWAII

Log of Boring

4

Approximate Ground Surface Elevation (feet MSL): 2423 *



Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
										ML	Brown **SANDY SILT** with traces of gravel (basaltic), very stiff, dry to moist (volcanic ash)
Sieve - #200 = 76.1%	29	53			42						
Sieve - #200 = 45.8%	20				25/6" +50/3"					SM	Brown **SILTY SAND** with some gravel, very dense, moist (volcanic ash)
Sieve - #200 = 53.9%	24				58		5			ML	Brown **SANDY SILT** with some gravel, hard, moist (volcanic ash)
											Gray and brown **GRAVELLY COBBLES (BASALTIC)** in a sandy silt matrix, very dense, dry to moist (clinker)
	15				50/3"		10				Boring terminated at 10.3 feet

Date Started:	July 26, 2021	Water Level: ▼	Not Encountered	Plate
Date Completed:	July 26, 2021			
Logged By:	S. Latronic	Drill Rig:	MOBILE B-53.1 *(Energy Transfer Ratio = 42.9%)*	A - 4
Total Depth:	10.3 feet	Drilling Method:	4" Solid-Stem Auger	
Work Order:	8190-00	Driving Energy:	140 lb. wt., 30 in. drop	